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INDEX.

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PROCEEDINGS.

Business Meeting, *January* 7, 1890.

Vice-President James in the chair.

There were twenty-five persons present.

The minutes of the October Business meeting were read and approved.

The following were nominated for active membership: Louis Wyler, E. L. Anderson, Dr. J. C. Culbertson, Philip C. Fosdick, S. Joseph Richard, C. D. Batelle, and Miss Lottie C. Howard.

Mr. Starling Fagin was elected to active membership.

The minutes of the Executive Board for October and November were read.

Prof. W. O. Sproull read a paper on "The Development of Color Perceptions."

A revised Constitution and By-Laws was presented and read by the committee appointed for that purpose.

The donations were announced and the Society adjourned.

Donations: From E. D. Cope, author, "Horned Dinosaurs of the Laramie"; Wilfred Guild, stone implement.

Scientific Meeting, *February* 4, 1890.

President Fisher in the chair.

There were twenty-six persons present.

The minutes of the December Scientific meeting were read and approved.

Prof. C. L. Herrick read a paper on "Facts and Theories Concerning Cerebral Anatomy" (as envoy for a technical paper on "Anatomy of the Nervous System of the Alligator").

Mr. E. O. Ulrich read a paper on "The Ostracoda."

Mr. Davis L. James read the following papers by title: "On

the Correlation of the Maquoketa Shales with the Cincinnati Group," by Prof. Jos. F. James; and "The Gasteromyces of the United States," by Prof. A. P. Morgan.

Mr. E. O. Ulrich, Curator of Geology, announced the formation of a Paleontological Section, to meet on Saturday afternoons.

Chas. A. Parke, Ernest W. Gunckel, Thos. Van Antwerp and J. R. Tressler were nominated for active membership.

Wm. Doherty, of Calcutta, India, was nominated for corresponding membership.

The President announced the death of Hon. Wm. T. Garratt, of San Francisco, Cal., and appointed a committee to prepare a suitable memorial.

The revised Constitution and By-Laws was then voted on for the first time.

The Society then adjourned.

SCIENTIFIC MEETING, *March* 4, 1890.

President Fisher in the chair.

There were twenty-three persons present.

The minutes of the February Scientific meeting were read and approved.

Prof. Joseph Moore, of Richmond, Ind., read a paper "On a New Species of Giant Fossil Beaver, from Northern Georgia," and exhibited an incisor tooth of same; also a skull of *Casteroides Ohiensis*.

Dr. Henshall read a paper entitled, "Our Museum: Its Needs and Uses."

Mr. Skinner read by title a paper on "The Indians of North America," by Col. James W. Abert.

W. C. Jirdinston, Dr. P. M. Bigney and Miss Mary Tatum were nominated for active membership.

J. R. Tressler, Ernest W. Gunckel, Thos. Van Antwerp, Chas. A. Parke, E. L. Anderson, Louis Wyler, Miss Lottie B. Howard, S. Joseph Richard, C. D. Batelle, Dr. J. C. Culbertson and Philip C. Fosdick were elected to active membership.

Mr. Wm. Doherty was elected to corresponding membership.

Mr. J. M. Cochran resigned.

The revised Constitution was read and voted upon and finally adopted.

The Society then adjourned.

DESCRIPTION OF SOME NEW GENERA AND SPECIES OF ECHINODERMATA, FROM THE COAL MEASURES AND SUBCARBONIFEROUS ROCKS OF INDIANA, MISSOURI AND IOWA.

BY S. A. MILLER AND WM. F. E. GURLEY.

LAST summer, Sidney J. Hare, E. Butts and D. H. Todd collected a lot of very fine crinoids in the Upper Coal Measures, at Kansas City, Missouri, many of which have fallen into the hands of one of the authors of this paper, Mr. Gurley. They are the finest specimens ever found in the Coal Measures, and it is, therefore, a pleasure to describe them. The stone quarries in the Waverly or Kinderhook Group, at Legrand, on the Chicago and Northwestern Railroad, in Marshall County, Iowa, contain some layers of yellowish, soft, sandy limestone, bearing the remains of Crinoids and other Echinoderms in a remarkably fine state of preservation, and Mr. Gurley visited the locality soon after its discovery, and succeeded in obtaining a large collection. He has been an active collector, in the rocks of Indiana, Illinois, Iowa and Missouri, for many years, and all the specimens here defined and illustrated are from his cabinet.

EUPACHYCRINIDÆ. n. fam.

The genera for which we propose the family name of Eupachycrinidæ, with the Genus Eupachycrinus as the type, all belong to the Subcarboniferous System and Coal Measures. The calyx is more or less globular or bowl-shaped, and consists of five basals, five subradials, five primary first radials, concave internally with a broad upper face, from one to three azygous interradials and no regular interradials. There are one or more brachials, and the arms are composed of a double series of interlocking plates, which bear short pinnules. The column is small and round. We include in the family Eupachycrinus, Delocrinus and Ulocrinus.

EUPACHYCRINUS MAGISTER. n. sp.

Plate I., Fig. 1, *basal view ; Fig.* 2, *azygous side view.*

This species is very large; calyx low and broad, somewhat saucer-shaped, bulged a little upon the azygous side, height about half the width, sutures deep, excavation extending about half the thickness of the plates, plates very strongly tuberculated, tubercles conical, elongated, and irregular in form and distribution.

The five basal plates are sunk in a cavity on the under side, projecting only half their length beyond the column; even this projection is tubercular; they form in the interior of the calyx a pyramid, which is pierced at the summit by a five-rayed opening, connecting with the canal in the center of the column; the points of the rays are rounded. The basal plates are made pentagonal by the truncation made at the points of the rays for the central canal. The diagrammatic views which have been made of the basal plates in this genus are incorrect in so far as they indicate a pentagonal opening with the angles directed toward the sutures, instead of truncating the plates, with a concave depression, for the five-rayed opening to the columnar canal. The two basals on the azygous side of the species before us are larger than the others, being nearly as large as the other three.

The subradials are very large, extend into the basal cavity and curve very gently upward; three are hexagonal, the two longer sides unite with the subradials, the two upper sloping sides, uniting with the first radials, are a little shorter, and the two under sides, uniting with the basals, are very short; two are heptagonal, the one upon the right of the first azygous plate being much larger, and, except the two short sides uniting with the basals, the other sides are of subequal length; the one upon the left has, in addition to the two short sides uniting with the basals, a short side adjoining the second azygous plate. Four of the first radials are pentagonal, twice as wide as high; the upper face is the full width of the plates, and projects over the interior of the calyx, so as to give the appearance of having great thickness when viewed from above. The other first radial, upon the right of the azygous plates, is quadrilateral, except a very slight truncation by the second azygous plate below the depth of the suture. The first radial is separated from the second, or brachial piece, on the outer face, by a wide suture, but within a crenated ridge extends from one angle of the plates to another, forming a pentagon, except as separated

by the second azygous plate; the ridge has a furrow upon the outer side in the central part of each plate, and within this there is a wide expansion which supports the brachial and arm pieces. The first azygous plate has four sides, rests between the upper sloping sides of two subradials, and the long under side of the first radial on the right, with the shorter side abutting upon the second azygous plate. The second azygous plate is hexagonal, curves inward and supports upon its two short inner faces the third and fourth azygous plates side by side. The vault and other parts unknown.

This species would seem to have its nearest affinity with E. tuberculatus, which is described in the Geo. Sur. Ill., Vol. II., p. 319; in that species, however, the plates are covered with regularly disposed, narrow, prominent tubercles, the tubercles being arranged in rows, while in this species there is no such arrangement. E. tuberculatus is figured in Geo. Sur. Ill., Vol. V., Plate XXIV., Figs. 9a and 9b, and the basal plates are proportionally larger, and the under sides of the subradials longer, than they are in the species under consideration, beside all the plates have a different shape, and the sutures are not excavated so deep as in the species before us.

Found in the Upper Coal Measures of Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

EUPACHYCRINUS SPHÆRALIS. n. sp.

Plate I., Fig. 3, *basal view; Fig.* 4, *azygous side view.*

This species is large and constricted at the top of the first radials; calyx somewhat like a widened or inflated sphere, width two-thirds greater than height, sutures distinct but not so deeply excavated as in E. magister; plates irregularly tuberculated, but tubercles not half as large as in E. magister.

Basal plates are sunk in a cavity on the under side, and project less than half their width beyond the column; subradials large, extend into the basal cavity and curve upward half the height of the calyx; three are hexagonal and two heptagonal; first radials pentagonal, though the one on the right of the azygous plates has a very short truncated side abutting upon the azygous plate; second primary radial, or first brachial piece, smaller than the first and of similar form, except inverted, and bears upon its upper sloping

sides the free arms; the one opposite the azygous side bears two arms, each of which has a single plate followed by a double series of interlocking ones; the others support four arms each; the upper sloping sides bear pentagonal plates, similar in form to the second radials, which are followed with a single plate that, in its turn, bears a double series of interlocking ones.

There are fourteen large, long arms, composed of a double series of interlocking pieces, rounded externally, and flattened upon the sides so that, in an accumbent position, they close somewhat like the arms of an Ichthyocrinus; the arms in our specimens are spread out and the extremities are not preserved; pinnules numerous, but not very long; column round, and rather small for such a large Crinoid.

This species has its nearest affinity with E. verrucosus, described in the Trans. Chi. Acad. Sci., Vol. I., p. 117, and redescribed and figured in the Report on the Palæontology of Eastern Nebraska, page 150.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ULOCRINUS. n. gen.

(Ety., *oulos*, solid, substantial; *krinon*, lily.)

This genus has a more or less globular or pyramidal calyx, and is related to Eupachycrinus and Delocrinus. There are five basals, forming a slightly convex pentagonal disc, or a low cup; they are of the same size and usually anchylosed; on the interior of the cup the columnar extension is round, depressed below the interior surface of the plates, and radiately furrowed like the articulating faces of the plates of many crinoid columns; on the exterior a star-like, columnar opening truncates the basal plates with the points of the five rays, between which there are radiating furrows for the attachment of the first columnar plate; by this arrangement the points of the basal plates are very thin, and disconnected only by the star-like perforation.

There are five subradials, each one of which may be as large or larger than the five united basals; all regularly alternate with the basals, and have the same form, except that one may be truncated by an azygous plate.

The first primary radials are pentagonal and regularly alternate with the subradials, except as interrupted by an azygous plate; they are much wider than high; the upper face is the full width of the plate, and projects over the interior of the calyx, so as to make a broad articulating face for the first brachial piece; the internal side of the first radial is concave; on the upper face of the plates a furrow extends from one angle of the plates to another, on the inner side of which there is a crenulated ridge, for the articulating brachial piece, and an interior central depression, and slight concavity at the central, internal margin.

There are no regular interradials. A single large quadrangular azygous interradial rests obliquely between two subradials and two primary radials, and forms part of the wall of the calyx; upon an angle of this, at the top of the calyx, a small plate intervenes and projects slightly above the first radials. The column is round. Other parts unknown, though very thick, heavy plates, bearing a spine like the first brachial plate of a Delocrinus, are found associated, and believed to belong to this genus.

The cup formed by the basal plates distinguishes this genus from Eupachycrinus and Delocrinus, both of which have a concave base and an interior pyramid formed by the basals; the second azygous plate does not truncate a subradial, and forms no part of the wall of the calyx in this genus, as it does in Eupachycrinus. It is probably as nearly related to Delocrinus as it is to Eupachycrinus, though at first view it would seem to be more nearly related to the latter. Type U. buttsi.

ULOCRINUS BUTTSI, n. sp.

Plate I., Fig. 5, *azygous side view; Fig.* 6, *basal view.*

The calyx of this species is pyramidal or has the form of half an ellipse, elongated; the plates are moderately thick, and convex externally so as to throw the sutures into wave-like depressions; the sutures are distinct, but the plates are not deeply beveled as is common in many species of Eupachycrinus; the surface was, probably, strongly granulous, as the better preserved plates are rough, though evidently slightly worn.

The basal plates are large and form a cup about half as high as wide; the perforation for the columnar canal is pentagonal and

star-like; the subradials are very large and longer than wide, which produces the great length or pyramidal form of the calyx; four of the plates are hexagonal and one heptagonal; four of the first radials are pentagonal, wider than long and truncated above the full width of the plates; the one on the right of the azygous side is possibly hexagonal, as one side may be slightly truncated by the second azygous plate; the upper face of the first radials bears a furrow extending from one angle of the plates to another, behind which there is a narrow, crenulated ridge, on which the second radials or brachial pieces articulated. The first azygous plate is irregularly quadrangular and rests obliquely in a notch on the top of a subradial and below the under sloping side of the first radial on the right, but it does not reach the second subradial. The second azygous plate is injured in our specimen, but it appears to have slightly truncated one angle of the first azygous plate, and the two abutting first radials at the top of the calyx.

Found in the Upper Coal Measures, at Kansas City, Mo., and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Mr. E. Butts, of Kansas City, who has done a great deal to make known the Natural History of that vicinity.

ULOCRINUS KANSASENSIS, n. sp.

Plate I., Fig. 7, azygous side view; Fig. 8, outline view regular side; Fig. 9, top view of calyx to show the prolongation of the first radials and contracted opening of the calyx; Fig. 10, basal view.

The calyx of this species is somewhat half-globular in form, though the height is more than two-thirds the width at the top; the plates are moderately thick and quite convex externally, so as to place the sutures in wave-like depressions quite as deep as they are in U. buttsi; sutures distinct, but the plates are not beveled; surface granulous.

The basals form an equal-sided convex pentagon, with a central depression for the star-shaped columnar canal; the subradials are each about the size of the united basals, a little wider than high, all pentagonal and nearly equal-sided except the hexagonal plate supporting the lower face of the azygous plate. The first radials are pentagonal, except the one on the left of the azygous plates, which becomes hexagonal by the very slight truncation made by

the second azygous plate; they are twice as wide as high; the upper face is the full width of the plate, and extends internally nearly one-third the diameter of the calyx; in the specimen described the width of the calyx is 1 3-10 inches, and the projection of these plates 4-10 inch, leaving the opening at the top of the calyx only 1-2 an inch, while the great concavity on the inner side of these plates will give an internal diameter of the calyx immediately below the top of the first radial of nearly an inch; the upper surface is broader than it is in E. buttsi, but the markings for the articulating brachials seem to be about the same.

The azygous plate forms part of the calyx, is quadrangular, nearly as large as a first radial, rests obliquely between two subradials and the under sloping side of the right first radial and a second under sloping side of the left first radial; the upper angle extends about as high as the upper face of the radials, and is very slightly if at all truncated by an angle of the small second azygous plate.

This species is remarkable for the great overlapping or interior projection of the first radials, and in this respect exceeds all known species of Delocrinus and Eupachycrinus. No part above the first radials is known, but some equally remarkably thick brachial plates, each bearing a very large spine, occurring at Rock Creek, in Jefferson County, Kansas, appear to belong to this species.

Found at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

DELOCRINUS, n. gen.

Ety.: *delos*, manifest, clear; *krinon*, lily.

The species belonging to this genus are usually robust, calyx basin-shaped, arms broad, composed of a double series of interlocking pieces joining neatly with each other, column round, plates thick, and surface smooth or finely granulous, not sculptured; basals five, occupying a concavity on the under side, and more or less hidden by the column, but forming a little cone in the interior of the calyx; subradials pentagonal and hexagonal, larger than the basals, the lower part inflexed by the depression of the base to meet the basal plates, the middle regularly arched, and the upper part forming a more or less acute angle between the under sloping sides of the first radials; first radials wider than high, pentagonal,

upper face truncated the entire width of the plate, and separated from the second radial or brachial plate on the outer face by a strong suture, but immediately within a straight crenated ridge extends from one outer angle of the plates to the other, on the upper face of the plates, which is furrowed upon each side so as to form a toothed hinge upon which the second radial or first brachial articulates; behind this hinge, in the middle part of each plate, there is a depression or socket for the reception of a tooth-like projection; on the under side of the second radial or brachial, a dart-shaped furrow also extends on the upper side along the line of union of the plates, commencing just within the angle arising from the union of the crenulated ridges and extending to the interior of the cup which receives a corresponding projection from the second radials; second radials or brachials pentagonal, produced externally in a more or less strongly developed spine, and bearing upon the upper or inner sloping sides the free arms, the first one or two plates of which are single, but above these composed of a double series of interlocking plates; when the arms are closed the pinnules are within, and the body is compact something like an Encrinus; there are no regular interradials; a single azygous interradial rests upon the truncated upper end of a subradial, between two first radials, and extends upward between the second radials or brachial plates; it is truncated at the upper end and followed by a single piece, beyond which the connection with the vault or proboscis is unknown. Type D. hemisphericus.

The species upon which this genus is founded was first defined by Shumard under the name of Poteriocrinus hemisphericus, in 1858, in the Transactions of the St. Louis Academy of Science, Vol. I, p. 221. Meek, in 1872, under the name of Scaphiocrinus (?) hemisphericus, Shumard, in the Report on the Palæontology of Eastern Nebraska, p. 147, Pl. V., Fig. 1a, 1b, and Pl. VII., Fig. 1a, b, c, redefined and illustrated Cyathocrinus inflexus of Geinitz, which is a distinct species as pointed out by Geinitz, though congeneric. In 1873, under the name of Scaphiocrinus (?) hemisphericus, Shumard, in Geo. Sur. Ill., Vol. 5, p. 561, Pl. XXIV., Fig. 5, Meek, probably, correctly identified and illustrated this species.

In 1880, in the Proceedings U. S. National Museum, Vol. 2, p. 257, White described a species under the name of Erisocrinus planus, which was redescribed and figured in Hayden's Twelfth

Ann. Rep. Geo. Sur. Terr., p. 127, Pl. XXXV., Figs. 5a and 5b under the name of Erisocrinus (Ceriocrinus) planus. Ceriocrinus being proposed and described as a subgenus of Erisocrinus and a comparison made with the Poteriocrinus hemisphericus of Shumard, and Cyathocrinus inflexus of Geinitz. Ceriocrinus was preoccupied, in the Echinodermata, by Koenig, and hence the use of the word by White is not allowable. The genus here under consideration and founded upon the Poteriocrinus hemisphericus of Shumard is not a subgenus of Erisocrinus, nor does it have any near affinity with it, probably not even family affinity, as will be apparent on the inspection of the species of Erisocrinus which have been illustrated. Its nearest generic relations are with Eupachycrinus or Ulocrinus. The Erisocrinus planus of White may not be congeneric with this species, because the small azygous plate does not rest on a subradial but stands upon two radials and projects upward between two second radials. Only the calyx is known, and it may be that other parts when found will distinguish it from this genus, or possibly unite it with Erisocrinus. We are inclined to believe that Wachsmuth & Springer were not very careful in their examination of these forms, for when referring to the two species, hemisphericus and planus, near the top of page 254, pt. 3, Palæocrinoidea, they are made to say, "We, therefore, can not agree with White in considering the two forms generically identical, and much less specifically," and yet, near the bottom of the same page they refer both hemisphericus and planus to White's proposed genus Ceriocrinus, and under the name of Ceriocrinus hemisphericus, they refer with approval to Meek's identification in the Report on the Palæontology of Eastern Nebraska, p. 147, which is simply a reproduction of the inflexus of Geinitz, which is a distinct species that they recognize on the same page.

In the North American Geology and Palæontology, S. A. Miller condemned Ceriocrinus of White on the ground that the name was preoccupied, and referred the hemisphericus to Eupachycrinus, the nearest allied genus then described.

This genus, so far as known, is confined to the Coal Measures of the Western States and Territories. We refer the following species to it:

Delocrinus craigi, (Eupachycrinus craigi) Meek & Worthen, Geo. Sur. Ill., Vol. VI, p. 527, Pl. XXXII., Figs. 1 and 1a.

Delocrinus fayettensis, (Eupachycrinus fayettensis) Worthen, Geo. Sur. Ill., Vol. V, p. 565, Pl. XXIV., Figs. 10, 10a.

Delocrinus hemisphericus, (Poteriocrinus hemisphericus) Shumard, Trans. St. Louis Acad. Sci., Vol. I, p. 221. Type of the genus.

Delocrinus inflexus, (Cyathocrinus inflexus) Geinitz, Carb. und Dyas in Nebraska, p. 62, Pl. IV., Figs. 20a, b, c, and doubtless the spines and some of the plates and fragments of columns figured on the same page under the name of Actinocrinus sp. The spines figured by Meek in the Report on the Palæontology of Eastern Nebraska, Pl. V., Figs. 2a, 2b and 2c, under the name of Zeacrinus mucrospinus probably belong to this species, while the form Fig. 1 called Scaphiocrinus (?) hemisphericus may be distinct. Delocrinus missouriensis n. sp. And very doubtfully the Erisocrinus planus of White above referred to.

DELOCRINUS HEMISPHERICUS, SHUMARD.

Plate II., Fig. 8, side view showing azygous plate and first brachial, with spine; Fig. 9, basal view of same; Fig. 10, inner side of brachial spine magnified two diameters.

Shumard defined this species as follows:

"The *body* of this species is sub-hemispherical, concave below and the surface finely granulose.

"The *base* is very deeply concave, pentagonal and completely concealed from view when the column remains attached to the cup. The five pieces of which it is composed are of a rhombic shape, longer than wide, and the interior edges nearly double the length of the exterior ones.

"The *columnar facet* is circular, crenulated on the border; the central perforation rather large and pentalobate. In the interior of the calyx the base forms an elevated conical protuberance.

"The *sub-radial* pieces are thick and longitudinally recurved; four of them are pentagonal, a little longer than wide, their superior edges gently arched and slightly longer than the infero-lateral edges; the basal edges are very short. The fifth sub-radial is hexagonal, its superior angle being truncated to support an anal piece.

"The *first radial pieces* are pentagonal, very massive, and as wide again as long. The inferior edges are slightly concave and of equal length in three of the pieces, but on the anal side they are

unequal. The superior edge is nearly straight and rounded The articular facet is very broad, nearly horizontal, and furnished with a prominent transverse ridge, which is situated nearest the external margin. Exterior to this is a small ridge which coalesces with the main one before reaching the extremity of the pieces. Both ridges are strongly crenulated

"*Anal pieces*—Of these pieces only one remains in the specimens before us. It is rather small, elongate hexagonal, and is wedged in between two of the first radials, above which it projects about half its length.

"The secondary radials, vault, arms and column are unknown.

"*Dimensions.*—Height of calyx, .30; width, .90; height of first radial pieces, .26; width of same, .42."

His specimens were from Hinkston Creek, Boone County, and on the Missouri River near Lexington, while our specimens are from Kansas City in the same vicinity. His definition is complete, as far as it goes, and we may add only that which our specimens disclose in addition.

The column is round and composed of alternately thicker and thinner plates radiately furrowed near the outer circumference of the articulating faces; the second radial or brachial articulates upon the crenated ridge on the top of the first radial, bears a tooth-like process that enters the socket in the middle of the posterior part of the first radial, and lateral processes that fill the furrows at the uniting joints of the first radials, and bears a strong spine, externally, that is directed upward at an angle of about forty-five degrees; the plates bear upon their upper inner sides the free arms; arms ten, the first plate articulates upon a serrated edge of the second radial, the next plate is wide and thin, and above this the arm consists of a double series of thick interlocking plates that make coarse wide arms, depressed convex externally, and flattened upon the sides almost as if cut by a knife so as to close up tight like an Encrinus; the first azygous plate is truncated and subquadrate upon the upper face which is serrated near the outer margin for the articulation of the second plate; beyond this the vault is unknown.

DELOCRINUS MISSOURIENSIS, n. sp.

Plate II., Fig. 11, *side view showing column; Fig.* 12, *basal view; Fig.* 13, *azygous side view.*

This species may be distinguished at first view from D. hemisphericus by the lower calyx and more angular outline, and the top of the calyx when viewed from below presents a pentangular outline; the basals extend slightly beyond the column; the subradials in the median part are sharply convex as distinguished from the gently arching plates in D. hemisphericus and do not extend as high proportionally as they do in the latter species, which reduces the height of the calyx; first radials regularly convex in the middle part but depressed medially toward the upper face of the plates which produces the pentangular outline when viewed from below; the second radials or brachials while exposing a very wide suture are not quite as thick and do not stand as upright as they do in D. hemisphericus, and have a more slender spine; the azygous plate is the same as in D. hemisphericus; the column is not as regular in the alternate arrangement of the thicker and thinner plates as in D. hemisphericus, the larger plates project far beyond the thinner ones and sometimes there are two or more thinner plates between the thicker ones.

Found in the Upper Coal Measures, in Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ÆSIOCRINUS, n. gen.

(Ety.: *aisios*, auspicious, coming at good time; *krinon*, lily.)

Column pentagonal; calyx bowl-shaped, plates smooth or finely granulous; basals five, forming a pentagonal flattened or slightly concave disc; subradials rather large, four hexagonal and one heptagonal, and curving upward so as to reach half the hight of the calyx; first radials five, pentagonal, wider than high and truncated the entire width for the brachials; one or more brachials in each ray supporting strong arms composed of a single series of plates; arms ten bearing pinnules; no regular interradials; a single azygous interradial rests upon the truncated upper end of a subradial, between two first radials, and is followed by two plates that connect with the base of the proboscis; proboscis long, composed of four series of gradually tapering plates bearing numerous transverse respiratory fissures or slits on the sides of the plates.

The calyx of this genus bears some resemblance to that of an Erisocrinus, but the pentagonal column and azygous plate distinguish it. The azygous plate truncates a subradial as in Delocrinus, but otherwise there is no resemblance between the two genera. The long flowing arms composed of single plates and the remarkably large and peculiarly constructed proboscis characterize this genus and distinguish it from all others. Its family affinities would seem to be with the Poteriocrinidæ, but probably a new family should be defined for its reception.

ÆSIOCRINUS MAGNIFICUS, n. sp.

Plate II., Fig. 1, *natural size of a specimen as it lies on a slab; Fig.* 2, *a free proboscis nearly entire and only slightly twisted; Fig.* 3, *portion of same magnified* 2½ *diameters to show more distinctly the respiratory openings; Fig.* 4, *an abnormal branching proboscis; Fig.* 5, *sectional end view of proboscis.*

Calyx deep, bowl-shaped, surface of plates finely granulous; sutures distinct but not beveled; basals forming a pentagonal flattened disc having an outline about twice the diameter of the column; subradials rather large, four hexagonal, one heptagonal, bending abruptly upward from the union with the basals, the upper angle extending high between the first radials so as to make the upper sloping sides of the hexagonal plates much the longer; first radials larger than the subradials, about one-half wider than high, all pentagonal with lateral and inferior sides of equal length and upper truncated sides extending to the fullest width of the plates; first brachial plates wide, short, rounded, separated exteriorly from the first radials by a beveled suture; second brachials wide, short, with long upper sloping sides for the articulation of the large arm plates; arms ten, long, round exteriorly and composed of short cuneiform plates; pinnules short and rather thick. Proboscis remarkably large, long and composed of four series of gradually tapering convex, tuberculated plates, somewhat similar in appearance to four round tapering columns placed together, giving transversely a subquadrate outline; there is no azygous or anal opening in the proboscis, but there are numerous transverse, respiratory fissures or slits in the longitudinal depressions; these slits exist on both

sides of every plate of the proboscis from the second brachials to the very top; some specimens of the proboscis have one or more intercalated plates near the lower end, and all are more or less twisted. There is a bifurcated proboscis in the collection which has five series of plates below the bifurcation, and three intercalated series at the bifurcation, so that each branch has four series, which we have illustrated. It is an abnormal specimen that may have resulted from an injury. The column is small, pentagonal, tuberculated and bore cirrhi to a greater or less extent.

This species was collected in the Upper Coal Measures, at Kansas City, and the specimens are in the collection of Wm. F. E. Gurley, of Danville, Illinois.

ÆSIOCRINUS HARII, n. sp.

Plate III., Fig. 1, natural size as it lies upon a slab.

This species is distinguished from A. magnificus, by having proportionally a much smaller and a smooth proboscis. The calyx is bowl-shaped; column pentagonal; basals of moderate size; subradials convex and extending half the hight of the calyx; first radials wider than high; first and second brachials and arms as in A. magnificus but proportionally smaller. The proboscis is much smaller in proportion to the size of the calyx than it is in A. magnificus, and the exterior of the plates is smooth, though the respiratory fissures in the two species are alike. This species is thus founded upon the surface character of the proboscis, and the proportionally larger calyx when compared with other parts of the body and arms.

These Kansas City fossils were collected in blue clay, where they were remarkably well preserved; but some specimens were injured by the collectors, who undertook to wash them when no water should have been applied. Many of the specimens were found with the heads downward and the arms spread out, leaving the base of the calyx upward, with the strong proboscis pressed to one side as shown in the illustration of this species.

From the Upper Coal Measures of Kansas City, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Sidney J. Hare.

HYDREIONOCRINUS PENTAGONUS, n. sp.

Plate II., Fig. 6, view of azygous side showing hight of calyx and upper truncated face for second radials; Fig. 7, basal view.

Calyx large, pentagonal and exceedingly depressed to the top of the first radials; plates very thick and sutures well defined; basals rather large and forming an octagonal ring around the end of the column, against the faces of which the subradials and three of the radials rest; subradials small, three triangular, one quadrangular, and the other pentagonal by reason of supporting the first azygous plate; they are slightly convex, and lie in furrows made by the angular convexity made by the first radials; first radials about twice as wide as high, the hight not much exceeding the thickness of the plates; the plates are hexagonal, highly convex, depressed toward the sutures, and truncated upon the outer faces, so as to give the calyx a pentagonal outline; the depressions at the sutures appear as furrows in the pentagonal outline of the calyx; first azygous plate quadrangular, narrow, resting upon the upper sloping side of a subradial and forming the bottom of the furrow between two first radials; second azygous plate heptagonal, slightly truncating two first radials; column round.

Second radials and succeeding parts above unknown, and it is therefore possible that this species is a Zeacrinus, but from the characters given the inference is, it possessed the ventral sac of an Hydreionocrinus, beside the latter genus had, so far as known, its greater development in the Upper Coal Measures, while the former is more characteristic of the upper part of the Subcarboniferous or Kaskaskia Group. It is unnecessary to compare this with any species heretofore defined, because it is easily recognized by its strongly marked characters.

Collected in the Upper Coal Measures at Kansas City, and now in the cabinet of Wm. F. E. Gurley, of Danville, Illinois.

ONYCHOCRINUS ULRICHI, n. sp.

Plate III., Fig. 2, azygous side; Fig. 3, symmetrical side, natural size.

Calyx depressed, saucer-shaped; plates finely granulous, sutures distinct; basals three, extending slightly beyond the column; four of the subradials pentagonal, the one opposite the azygous side

being the larger one and all sharply pointed at the upper angle; the other one is hexagonal with an upper concave articulating facet for the first azygous plate; primary radials five in each ray, very gradually decreasing in size upward and becoming more and more sharply rounded; each one is wider than high and the sutures are transverse, with the exception of a slight concave central, exterior depression; the fifth plate is angular in the central part of the upper face and supports the two series of brachials; the brachials and arms are very short and thick, and the sutures between the plates become more and more sinuous toward the extremities; the first arm is given off at about the fourth brachial, and above this there are twelve or more short, branching, curving arms that form a cluster at the end of each ray.

The first regular interradial is large and octagonal; it is followed by three plates and these by five, and above they are smaller and more numerous; four interbrachial pieces are visible in our specimen, and there are, probably, more; the azygous plates are small, short, and sutures sinuous.

Found in the Keokuk Group, at Crawfordsville, Ind., and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Prof. E. O. Ulrich, of Newport, Ky.

AGARICOCRINUS SPLENDENS, n. sp.

Plate IV., Fig. 1, *side view with arms; Fig.* 2, *basal view of same.*

This species is of medium or rather under medium size; base concave; surface granulous; basals small; first radials small; second radials quadrangular, wider than long; third radials pentagonal, wider than high, and supporting upon each of the upper sloping sides a thin brachial plate, which is followed by another thin plate having two upper slightly sloping sides which support the regular interlocking series of the arm plates; arms, twelve, three in each ray adjoining the azygous side, and two in each of the other three rays; they are a little longer than the greatest diameter of the calyx, rather small and taper to a point; pinnules fine; regular interradial areas narrow, the first plate resting between the second radials, which is followed by two smaller ones situate between the third radials and the first brachials; azygous area having one plate followed by three of nearly the same size,

which gives breadth to the area between the third radials and the brachial plates; the column is round and composed of alternately thicker and thinner plates. Our specimens do not show the vault.

This is a beautiful little species, quite different from any heretofore described, and occurs in the Keokuk Group, at Crawfordsville, Ind. It is in the collection of Wm. F. E. Gurley.

BATOCRINUS MARINUS, n. sp.

Plate IV., Fig. 3, *side and basal view; Fig.* 4, *outline view of plates on azygous side.*

Species of about the average size; calyx expanded at the arm bases so as to be wider than high and to make the openings through the vault from the arm furrows at right angles to the calyx; surface of the plates flattened and finely granulous; basals three, upright and forming a circle which appears as if it were the enlarged end of the column; first radials wider and larger than the second and third together, three heptagonal and two hexagonal; the upper face is truncated for the second radial, and the upper sloping sides support the first interradials; second radials quadrangular, a little wider than high; third radials wider than the second but not longer, pentagonal or hexagonal, the lower lateral sides spreading so as to give the greatest width at the angles made with the upper sloping sides; the upper sloping sides support the secondary radials; secondary radials two by ten, wider than long, somewhat variable in size and shape, the second one bearing upon its upper sloping sides a single tertiary radial; the tertiary radials are succeeded by a double series of interlocking arm plates; arms twenty, rather small, slender, gradually tapering and composed of a double series of plates, alternately interlocking; in our specimen they are coiled together on the vault around the base of the proboscis; pinnules very numerous. Regular interradials five, the first one polygonal, about as large as a first radial and nearly as large as the other four; the first one is followed by two plates and these by two which are between the second secondary radials and the upper sloping sides of the tertiary radials; there is one intersecondary radial in each area; azygous interradials nine, the first one in line with the first radials and of the same size, this is followed by three smaller ones, and these again by three, and these by two which fit

between the under sloping sides of the tertiary radials; the proboscis is broken off in our specimen at the top of the folded arms.

Found in the Keokuk Group at Crawfordsville, Ind., and now in the collection of Wm. F. E. Gurley.

BATOCRINUS JUCUNDUS, n. sp.

Plate IV., Fig. 5, *azygous side with arms; Fig.* 6, *symmetrical view with arms removed, showing proboscis.*

Species rather small; calyx globose, nearly as wide as high, height of calyx a little more than height of dome to the base of the proboscis; arm bases very slightly projecting, and arm openings projected upward; surface of the plates smooth or finely granulous, more or less convex or tumid; basals three, short, upright, and forming a pentagonal ring around the column; first primary radials much wider and larger than the second and third together; on some specimens there is an elongated, transverse tubercle on each one, the upper face is broadly truncated for the inferior face of the succeeding radial, and the upper sloping sides support the first interradials; second primary radials quadrangular one-half wider than long; third primary radials wider and larger than the second, pentagonal or hexagonal, the lower lateral sides spreading so as to give the greatest width at the middle part of the plate or at the angles made with the upper sloping sides; the upper sloping sides support the secondary radials; secondary radials 2x10 wider than long, the upper the larger, but both of them variable in size and shape; six of them have upper sloping sides for tertiary radials, while four of them bear only a single tertiary radial; each second secondary radial in the ray opposite the azygous side bears a single arm and one of the lateral secondary radials on each side bears a single arm; there are, therefore, only sixteen arms; a single plate follows each tertiary radial, and above this the arm is constructed of two series of small plates alternately arranged; the arms are rounded on the outer side, gradually tapering and bear numerous long pinnules, composed of comparatively long pieces; regular interradials in some areas two and in others three, the first one polygonal and larger than any other plate above the first primary radials; when it is followed by two interradials they are together no larger than a single secondary interradial; azygous interradials

eight or nine, the first rests between the upper sloping sides of two basal plates and is in line with the first radials; it is followed by three plates in the second series, and in one specimen three plates in the third series and in another four; these are followed by a single plate projecting an angle up between the under sloping sides of tertiary radials; the vault and proboscis are constructed of highly tumid polygonal plates; the proboscis extends as far as or beyond the arms; column round.

This is a handsome little species, distinguished by its sixteen arms and the structure of the calyx from all others.

Found in the Keokuk Group at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

DICHOCRINUS CINCTUS, n. sp.

Plate IV., Fig. 10, *symmetrical side view*; *Fig.* 11, *azygous side, showing vault and valvular opening*; *Fig.* 12, *summit view.*

Calyx obconoidal, nearly twice as high as wide, somewhat truncated at the arm bases, except upon the azygous side, surface of the plates bearing a collection of fine longitudinal lines from the rim at the base, over the central part of the first radials, to the first rim plates, with fine transverse lines between, especially near the top of the calyx; sutures not impressed, and the transverse and longitudinal lines cross without interruption; the band or rim at the base suggests the specific name. The two basals form a little cup, the height of which is equal to the greatest diameter; they are contracted above the base so as to leave a small, smooth, half cylindrical rim or band at the bottom of the cup; the first radials are about twice as long as wide, very gradually increase in width to the upper truncated end, which bears a concave facet, a little more than one-third the width of the plate, for the attachment of the second radial or first brachial piece; second radial thin, rounded; the third radial a little thicker, rounded, and bearing upon its upper sloping sides the free arms; arms ten, long, rounded externally, composed of a single series of thin plates, bearing long, strong pinnules closely packed together.

Regular interradials forming part of the vault, and standing but very little above the upper truncated edge of the first radials; first azygous interradial as large as the first radials, inflected toward the

vault, and bearing fine longitudinal lines in the middle and lower central part, and transverse lines on each side of these on the upper part; the succeeding plates cover a moderately convex ridge, expanded a little above the other part of the vault which extends to the side of a central nipple occupying the summit of the vault, and at the junction there is a valvular opening, but it is not connected with the central elevation; this nipple-like elevation is covered with very small polygonal plates, and from the lower part of it five ambulacral ridges radiate to the second and third radials, which ridges are covered with minute polygonal plates. The column is round and composed of thin plates with sharp projecting edges.

Found in the Kinderhook or Waverly Group, at Le Grand, Iowa, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS GRANILINEUS, n. sp.

Plate IV., Fig. 7, natural size.

Calyx low, basin-shaped; sutures well defined; basals small and hidden by the column; subradials small, hexagonal, except one on the azygous side, which is truncated at the top and heptagonal; first radials wide, short, pentagonal, and truncated on top, where they have their greatest width; second radials quadrangular, short, wider than the first, and having the greatest width at the upper truncated surface; third radials wider than the second, pentagonal, very short, with steep upper sloping sides, which are slightly curved to receive the free arms; arms short, composed of short cuneiform plates, so strongly arched in the middle as to form a subangular ridge down the back of all the rays, on which the granules are so united as to form a keel; all the arms preserved in our specimen (six in number) bifurcate on the sixth plate, and above this the bifurcations are irregular, one of them bifurcating on the fourth plate, and others do not seem to bifurcate at all; the arms are flattened so as to fit closely together as in Zeacrinus; pinnules not observed; the first azygous plate is inserted obliquely between a subradial and the under sloping side of a first radial, with the truncated lower end resting against another subradial; this plate is pentagonal; the second azygous plate rests upon the first above-mentioned subradial, and between the radials on the left and

the upper sloping side of the first azygous plate on the right; the higher azygous plates are not shown in our specimen; the column is rather small and obscurely pentagonal near the head.

The surface of the plates of body and arms is strongly granulated, and this, with the angularity of the arms and the union of the granules forming a sharp ridge or keel down all the rays, strongly characterize this species, and suggests the specific name. It probably belongs to that branch of the genus Poteriocrinus for which Wachsmuth suggested the name Pachylocrinus.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS CRAWFORDSVILLENSIS, n. sp.

Plate IV., Fig. 8, natural size.

Species large, robust; calyx obconoidal, expanding very gradually from the large column, longer than wide, and composed of smooth rounded plates with well defined sutures; basals large, widening but little upward, pentagonal, about as wide as high; subradials longer than wide, expanding but little upward, those shown in our specimen hexagonal, the two on the azygous side probably heptagonal; radials pentagonal, very little wider than high, the articulating surfaces occupying the entire width of the plates; the second radial or brachial plate in the ray opposite the azygous side is pentagonal, about as high as wide, rounded, and supports upon its two upper sloping sides free arms, one of which bifurcates on the third plate above, and the other does not divide; the arms are robust, long, very slowly tapering, rounded, and composed of thick cuneiform plates; column large, round, composed of thicker and thinner plates, the articulating faces of which are marked by radiating furrows, which show the serrated edges. Proboscis and other parts unknown.

This species belongs to that branch of Poteriocrinus for which Wachsmuth proposed the subgeneric name of Scytalocrinus. Its characters are very strongly marked, and it resembles P. missouriensis, from the St. Louis Group, about as much as it does any other species in the genus.

It was found in the Keokuk Group, at Crawfordsville, Indiana, and belongs to the collection of Wm. F. E. Gurley.

POTERIOCRINUS VERUS, n. sp.

Plate IV., Fig. 9, natural size.

Species medium size; calyx obconoidal, expanding very gradually, as long as wide, and composed of smooth rounded plates; sutures distinct; basals pentagonal, standing upright, nearly as high as wide; subradials hexagonal on the symmetrical side, about one-half larger than the basals and a little longer than wide; radials pentagonal, wider than high, a little smaller than the sub-radials, convex, truncated the entire width of the plates, with suture gaping; there are five brachials in two rays and seven in the other in our specimen before a bifurcation is reached; these plates are nearly as long as wide, round externally, and very slightly constricted, and the sutures are gaping; the last one has very steep upper sloping sides for the arms; arms ten, long, composed of very long constricted plates with slanting gaping sutures; proboscis long; our specimen shows five subquadrate plates where the arms are broken away, indicating that the proboscis extended nearly or quite to the ends of the arms. Column round, and articulating faces of the plates radiately furrowed.

Found at Crawfordsville, Indiana, in the Keokuk Group, and now in the collection of Wm. F. E. Gurley.

SCAPHIOCRINUS MANUS, n. sp.

Plate IV., Fig. 13, azygous side, natural size.

General form of calyx and arms having a fancied resemblance to a hand; calyx cup shaped, height about half the diameter at the top, plates convex and sunken at the angles of the sutures; basals hidden within a shallow depression surrounding the end of the column; subradials hexagonal, except one on the azygous side which is truncated at the top and heptagonal; they are larger than the basals, and about half as large as the first radials; first radials pentagonal, one-half wider than high, convex at the upper part, truncated the entire width, and separated from the brachials externally by a wider suture. There is only a single brachial in each ray, and it is rather larger than a first radial, pentagonal, constricted, angular, and supports on its upper sloping sides the free arms; the two arms on the left of the azygous plate and the one

on the right bifurcate on the eighth plate, and the second arm to the right of the azygous plates bifurcates on the tenth plate ; the plates are very slightly wedge-shaped, and have their thickest margins produced into nodes, the alternate arrangement of which gives the arms a rough aspect; pinnules coarse, making the head appear full and dense. The first azygous plate rests between the first two radials, the under side of the first radial on the right, and the second and third azygous plates; the second azygous plate is of the same size as the first, rests on the truncated end of a subradial, and abuts upon a first radial and brachial on the left, the first and third azygous plates on the right and another azygous plate at the top; the third azygous plate is a little smaller, and abuts a brachial on the right. Column and vault unknown.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

DESCRIPTION OF A NEW SPECIES OF GIGANTIC BEAVER-LIKE RODENT.

By Prof. Joseph Moore, of Earlham College, Richmond, Indiana.

The tooth which is the subject of this sketch was found in Northern Georgia in the late war time by Dr. C. S. Arthur, of Portland, Jay County, Ind.

The Doctor, who has a habit of looking for specimens, was searching some old forsaken gold diggings, in the hope of adding some "*dust*" to his collection, when he discovered near the bottom of a gravelly pit one end of the specimen now before us. It was six to eight feet below the surface, and, as the Doctor informs us, was taken out entire.

The cracks and breaks are probably the result of drying or of exposure in carrying.

I take this specimen to be the left upper incisor of some Rodent—very probably of the Genus Castoroides. As some experienced observers have questioned as to the place of the tooth, I offer the following reasons for thinking it can not be a lower incisor: viz., since the branches of the lower jaw meet at an angle and the incisors are bedded posteriorly in the *outer portion* of the jaw, they must rapidly approach each other as they extend forward from their bases, so that as they project from their sockets they would cross each other if they did not twist outward. This direction of lower incisors towards each other in their growth causes them to crowd together and sustain each other. As a consequence they are worn on their adjacent surfaces. This tooth has *no twist* and *no wear* on its proximal surface.

In the second place, the curvature of the tooth is quite too rapid for a lower incisor.

Its weight is	24¼	oz. av.
Its length along border of greatest convexity is .	18½	inches.
Length of inner curve from base to hinder edge of beveled crown, ...	11	"
Distance across from base to apex, outer to outer point	11⅛	"
Greater diameter, fore and aft, at base, . . .	2¼	"

Greater diameter, fore and aft, near apex, . .	$1\frac{5}{8}$ inches.
Lesser diameter, right and left, at base, . . .	$1\frac{5}{16}$ "
Lesser diameter, midway, ...	$1\frac{1}{4}$ "
Lesser diameter, across beveled crown, . . .	$\frac{7}{8}$ inch.
Length of beveled crown, fore and aft, . .	$2\frac{1}{8}$ inches.
Circumference at base, ...	$6\frac{3}{16}$ "
Circumference at middle, ...	$5\frac{3}{4}$ "
Circumference at distal end, ...	$4\frac{1}{2}$ "
Standing the tooth on its base and apex, the height of the arch is	$6\frac{1}{8}$ "

The curvature at first sight along the median line would appear to be very nearly an arc of say one hundred and sixty degrees of a circle whose radius is six inches. On measurement, however, it was found to have a more rapid curvature as we approach the outer extremity. The proximal side, that which faced its companion incisor, is approximately flat as compared with the distal side, which approaches to semi-cylindrical. The flatter side is by no means mathematically flat. It has a shallow valley-like mesial groove extending from end to end very near the middle, so that a section at any point would give us an outline similar to that of a lima bean. The sinus is about one-eighth of an inch deep, as measured by laying a straight-edge from ridge to ridge on either side. Said sinus has a corresponding ridge on the opposite wall of the hollow base, almost the whole length of the pulp cavity; though the ridge on the inside is not so well defined as the sinus on the outside.

This whole specimen has a fresh look about it, which tends to dissipate the idea of its being a fossil. The two cross breaks and the cleft base give ample opportunity to study the ivory, enamel, and the pulp cavity. The ivory has a clean, creamy look, showing the grain, the mode of growth, laminæ, etc.

The pulp cavity is eight and one-fourth inches long, following the curve. The thickness of the wall is reduced to a mere blade at the base, but thickens gradually outward as the cavity narrows. This cavity is nearly flat on the side corresponding to the flatter side of the tooth, and semi-conical on the other.

The enamel invests the entire body of the tooth, showing all around the border of the beveled crown and around the borders of the sections, one of which is three and a-half inches from the apex, the other near the middle.

One very striking feature is the ribbing and fluting of the enamel throughout the length of the tooth.

The ribs are about a line in width on an average, and half as high, and the flutings or spaces between them are not of uniform width, but would average about three times the width of the ribs.

Three inches from the base we count forty-two ribs in making a circumference; near the middle we count thirty-one, and at the base of the beveled crown twenty-five.

Many of these ribs fade out on the surface as we pass from base to apex, while a few of them become confluent with the nearest one on either side. The lengthwise sinus on the flatter side has no rib in, or crossing, its deeper portion till we near the apex, where a single rib falls into the valley from the outer curve. These ribs appear the more prominent from their being glistening white, especially toward the crown, where they have been polished by exposure.

We often observe in teeth of various species, recent and fossil, a tendency to crack and split, especially the canines of dogs, bears, boars, lions, etc.,—the same is true, in a marked degree, with the incisors of rodents, so that it is difficult, oftentimes, to keep a beaver's incisors entire even for a few months. And this tooth has its well-defined cleavage plane, for, though unsymmetrical, it is bilateral. The plane of cleavage is well seen where the base is cleft, leaving smooth selvage edges and faces. It is seen equally well in the curved line making the longer diameter of the sections, and the same seam shows distinctly running the longer diameter of the crown, and along the part of the inner arch where the tongue has rubbed the surface.

The lengthwise fluting of the tooth is shown, not only in the enamel but correspondingly in the outer portions of the underlying dentine, though in a less marked degree.

The surface is further marked by many rings at right angles to the fluting, giving the surface a corrugated appearance. These are more distinct toward the base, but are scarcely discernible past the middle.

They are from one to three or four lines apart, and many of them so indistinct as to require the light to fall nearly horizontally across them in order to make them visible. Two of these girdles, the one about three and the other about six inches from the base, are so marked by width and prominence as to suggest the annual rings on a cow's horn.

As to the general surface of the enamel, it has myriads of very minute shallow punctures and papillæ, coarser and finer, giving it a granulated or sandpapery look.

Over all this, and dipping into the minutest inequalities of surface, is a brown film, hardly thicker than a coat of thin paint, which I take to be cement.

Some four to five inches from the apex is a line which appears to indicate where it was surrounded by the gum, and consequently the extent of projection beyond the socket.

It only remains to speak of the beveled crown so characteristic of the rodents in general. It is two and one-eighth inches the longer way (fore and aft) and seven-eighths of an inch laterally.

In general outline it would be ovate-oblong but for the gentle re-entrant curve caused by the sinus of the flatter side. It is an ivory face (bounded by a ring of enamel) as smooth as the bottom of a flat-iron and very nearly as flat. It is, however, slightly concave. Lay a straight-edge on the crown the longer way, and the face will be seen to sway away from it by about half a line near the middle of the basin. This face shows distinctly the gently curved line which is the outcrop of the plane dividing the tooth bilaterally from end to end.

There are also a few faint scratches on this ivory face, caused by the enamel of the antagonist incisor. The crown meets the anterior curve at an angle of about forty-five degrees.

To any specialists who may not be familiar with this specimen I have offered the above description in the hope to aid them in the study of it.

And what were the zoological relations of the creature which once sported this incisor and which dwarfed even the Capybara of the present day and Castoroides ohioensis of the past?

In the fluted, ribbed, corrugated, and granulated structure and appearance of this tooth, together with a peculiar way in which the ribs near the outer curve, as they extend backward, incline toward and lose themselves in the line of greatest convexity, one is continually reminded of Castoroides, to which genus it probably belongs.

But by no known principles of classification can I think it identical with Castoroides ohioensis. Suffice it for the present to say that, on comparing it with the incisors, entire, of a specimen of C. ohioensis recently found in Randolph County, Ind., with two teeth

found in separate localities in Darke County, O., with the description of the first known tooth given by Foster, and with the casts of the Clyde specimen, it has five times the bulk of any one of them. But that does not signify so much as the striking difference in form, as will be seen from accompanying plates and description. C. ohioensis, so far as I have had opportunity to observe, has little or no enamel either on the lingual or proximal surfaces of the upper incisors. This Georgia tooth has a well-defined layer of enamel entirely around it.

I propose for this species the name, Castoroides georgiensis; until the discovery of other parts may perhaps throw clearer light on its generic relationships.

DESCRIPTION OF PLATES V. AND VI.

One-half Natural Size.

CASTOROIDES GEORGIENSIS.

LEFT UPPER INCISOR.

PLATE V.

Fig. 1. Showing distal side with its ribs, grooves and cross corrugations.

1 *a*. Enamel scaled off.

1 *b*. Fore-shortened view of crown.

1 *c*, 1 *c'*. Showing how much was free as it rested in socket.

Fig. 2. The crown, showing line of median fold and scratches by enamel of antagonist incisor.

Fig. 3. Showing section three inches from extremity.

PLATE VI.

Fig. 1. Showing mesial sinus *s* and plain of clavage.

1 *a*, 1 *a'*. Breaks.

1 *b*, 1 *b'*. Pulp cavity.

Fig. 2. Slab split off from base of Fig. 1.

A CAVE IN THE CLINTON FORMATION OF OHIO.

BY PROF. JOSEPH F. JAMES, M. SC., U. S. GEOL. SURVEY.

(Read May 6, 1890.)

THE Clinton formation as known in Ohio consists of a thin stratum of limestone, seldom attaining a greater thickness than fifteen feet. It is found fringing the outcrop of the Lower Silurian in Southwestern Ohio. The rock is more or less porous and liable to weather, and this, in addition to its limited extent, makes it of little use as a building stone.* The passage of this stratum has never been directly traced across the Ohio line into Indiana, and its presence is not indicated in the Geological map of the State; at the same time in some of the counties near the border it has been noted.

The porosity of the rock has rendered it liable to disintegration through the influence of percolating waters, and it is possible that had the formation attained a greater thickness in any locality, it would have been as prolific in subterranean cavities as the lower Carboniferous limestone of Kentucky. The hard blue limestone and the soft crumbling shales of the Cincinnati group are not fitted for the formation of caves in any portion of their extent. Consequently such a thing as a cave in any place in Southwestern Ohio where these strata are found, is unknown. In the Clinton group, however, there is found a cave of small extent, which I investigated a year or so ago, and as I believe no very full account of this has been published, a little space will be devoted to its consideration.

The outcrop of the Clinton has not been satisfactorily traced in the field. Between the towns of Morning Sun and Camden, in Preble County, Ohio, the turnpike passes over an exposure, and as the wagons or buggies roll along, a hollow, rumbling sound is heard, as if the vehicles were passing over a bridge. This is a part of the cave, and though apparently of considerable extent, it is not possible to explore this portion because of the lack of any

*In the Fourteenth Annual Report of the Geology of Indiana, for 1884, it is stated that (p. 51) this group has a thickness of twenty feet in Fayette County, and that it has been used in locks of canals, and as foundations for buildings.

entrance. There is an entrance, however, to one portion, in a field about three hundred yards from the road.

I had been told before visiting the spot that it was possible to penetrate several hundred yards under ground; that there was a large entrance, into which a man could walk upright; and that the floor was paved with bones. Persistent inquiry and search did not reveal this entrance, so we were compelled perforce to take what we could find. This was a hole in the ground, descending perpendicularly some six or eight feet. At the bottom was an opening under a projecting ledge of rock. Once inside, there was found a narrow descending passage. It was about two and a-half feet high at first, and about twenty feet from the mouth opened out into a cavity about large enough to turn around in. At one side was a slight depression, and then roof and floor met. At another side was a small opening about a foot high, through which, by patient, snake-like movement it was possible to crawl. Beyond this was another slight enlargement, also of sufficient size to turn around in, and that was all. At one side was a funnel-shaped cavity about two feet in diameter and of the same depth, with a hole at the bottom. This had been made, apparently, by water running in from above. All around floor and roof came together, except that at one side was an opening too small to attempt a passage. This was the extent of the cave. The floor was of dried mud, which becomes converted into a mass of sticky clay in wet weather.

It is probable that at one time the cave had considerable extent. About the mouth or entrance are many huge fragments of rock which have fallen as the earth has been washed away below. That these have not fallen very recently is shown by the presence of trees of considerable size, and of from fifty to seventy-five years growth, close to one of the fallen masses. Probably also before the cultivation of the land above, the cave was readily accessible. But the washing in of earth has gradually filled up the passages and the most of the cavity. Formerly, it is said, there were a number of places where it was easy to enter. These have been stopped up with dirt and stones, partly to prevent cattle from falling into them, partly to enable the land to be cultivated.

DEVELOPMENT IN THE DARK ROOM.

By T. B. Collier.

(Read before the Photographic Section of the Society, March 17, 1890.)

(ABSTRACT.)

There is nothing in the whole range of photography, about which so much has been said and written as this subject of development, and I recognize at the outset the difficulty I shall experience in interesting you. What I shall say, however, will be denuded of all technicalities, and presented in the plainest language possible, so that the youngest members here can not fail to understand my meaning.

As you all know, the dry plate, in whatever form we find it, is simply a gelatine emulsion, of which the bromide of silver is the principal ingredient, supported by a backing of glass, paper, celluloid, or what not. The action of the light upon this emulsion precipitates the bromide of silver in quantities directly proportionate to the intensity of the light; and the subsequent treatment of the plate by the developer, and the reduction of unprecipitated bromide of the hypo-solution, produces that condition which is termed negative. Now in the reduction of the silver bromide two agencies are employed—an acid and an alkali. I shall not attempt an explanation of the chemical changes that take place during the development of a plate, but confine my remarks to the results obtained so far as I am acquainted with them. The action of the developer, or rather the action of the two principal ingredients, acid and alkali, has been very correctly likened to the relation that may be said to exist between generated steam as a motive force, and the machinery by which that force is intelligently applied to the movement of a body, the alkali corresponding to the steam, and the acid to the machinery, by which the force of the former is directed. Bearing this illustration in mind, it is easy to understand that there is a fixed relationship of alkali to acid, and if the proper proportion of one to the other is varied from, the effectiveness of the developer is reduced in a corresponding degree.

Beginning with the first developer I ever used, and which I found to be the simplest, I would call attention to the ferrous

oxalate, or as it is familiarly known, the iron developer. Ferrous oxalate developer is composed of the neutral oxalate of potash and the sulphate of iron; the proportion being one part of a saturated solution of the sulphate of iron (which has been rendered acid by the addition of a sufficient quantity of sulphuric or tartaric acid to turn blue litmus paper red) to six parts of a saturated solution of the neutral oxalate of potash. This developer may be weakened, or its action restrained, by the use of a few drops of a twenty per cent. solution of bromide of potassium (say three drops to the ounce of developer), or what is to my mind better still, by the addition of a little water; and it may be accelerated or strengthened by increasing the proportion of the iron to oxalate, from one to six, to one part of the iron to four parts of the oxalate. But if a larger proportion of the iron is used, a yellowish, muddy precipitate is formed, which renders the developer unfit for further use. This developer, if old and weak, may be greatly accelerated by the introduction of a one to four solution of hyposulphite of soda, (about the strength of a fixing bath) in the proportion of one drop of the hypo-solution to an ounce of developer.

I have, on numerous occasions, when my developer appeared to have lost its active principle, dipped the end of my finger in my fixing bath, and transferred to the developer the small amount of hypo that adhered to it. In some cases the effect was magical, and the developer, which was before inert, took on new life, and the development was carried to a satisfactory termination. The plate would almost immediately present the appearance of overexposure, and an unmistakable cloud would spread rapidly over it. And to one who had never made the experiment, the plate would soon appear hopelessly fogged. But upon washing off the old developer and pouring on a fresh solution, the plate would acquire sufficient density, and upon fixing would show a negative of surprising pluck and brilliancy. This, however entertaining as an experiment, is extremely hazardous, and I would not recommend its trial upon a valued plate. In using this developer, it is important to remember that the iron solution must be poured into the oxalate—not the oxalate into the iron—for in this latter case, the yellowish, muddy precipitate before spoken of is sure to be formed, and your developer wasted. I make it a rule to filter all of my solutions, and when properly made and filtered, the oxalate

of potash should be as clear as the purest spring water, while the iron solution should be of a beautiful transparent pea-green color; and when mixed together, they will immediately change into a rich color, varying from a topaz sherry to a ruby red, according to the proportions of the ingredients used. These two solutions when properly stoppered, will keep indefinitely; and when mixed in the proportion of one part of iron to six parts of oxalate, will last for months if the air is all excluded. The action of air upon this and all other developers is very injurious, causing oxidation, and how to prevent this oxidation has been the subject of much discussion and many experiments.

I have very little faith personally in the success of any attempt to preserve the developer by the addition of chemicals, although it must be admitted that glycerine and alcohol appear to approximate in some degree to the desired result; and none of the mechanical contrivances invented for the purpose of getting the developer out of the bottle, without at the same time admitting the air, have proved successful. The simplest device I have yet heard of for excluding air from the bottle in which the developer is kept, when one has not sufficient developer to completely fill the bottle, is to drop into it a sufficient number of pebbles, or glass marbles such as all school-boys have, to expel the air. Then when properly corked, the oxidation is reduced to a minimum. This plan, of course, necessitates the use of wide-mouth bottles.

This ferrous oxalate developer I consider one of the most useful an amateur can have. There is no long formula to remember —no weighing out of the ingredients into grains and fractions of grains—it is cheap, reliable, easily controlled, and the printing qualities of the resulting negative, if the plate has been properly timed, can not be excelled. The greatest objection I have found to its use is the fact that it stains almost indelibly the hands, and anything in the nature of cloth with which it comes in contact.

With this developer, as well as with all others, I have come to the conclusion, late in the day, that the proportions of acid and alkali should be uniform, no matter whether the plate is under-timed, correctly timed, or over-timed. The developer may be weakened by the use of water, if you think it is desirable, but my advice to beginners is to disregard entirely the suggestions they will be sure to meet with, that a little more of No. 1 (acid) will give increased density, and that a little more of No. 2 (or

alkali) will bring out the detail. These are the Scylla and Charybdis upon which more hopes have been wrecked than anything else in photography.

My first experience with pyro and ammonia was, fortunately for me, decidedly disastrous; I managed to hopelessly fog every plate I attempted to develop, and the fumes of the ammonia affected me so unpleasantly, that I for once and all abandoned this combination. But with pyro and soda, and with pyro and potash, the case was different. I think there must be not less than a thousand different formulæ for pyro developer, and I struggled along with one after another, with varying success, but failed to realize that any of them possessed much advantage over the ferrous oxalate, for which latter I have to this day a great fondness, and am never without it. I had read so much about the advantage of pyro over iron, that I was determined to find out all about it; but after floundering around until I was completely bewildered, I at length hit upon a formula used by Mr. F. C. Beach, of the New York Photographic Society, which comes as nearly being perfect as any pyro developer I have ever used. It is extremely concentrated, and for this reason valuable when one is on an extended trip, where it is impossible to get the ingredient of which it is prepared. The formula is as follows:

No. 1.	Pyrogallic Acid	1 oz.
	Warm Water	4 "
	Sulphite Soda (Crystals)	4 "
	Dilute Sulphurous Acid	3½ "

Dissolve the sulphite of soda in the warm water, add the dilute sulphurous acid, then the pyro, and finally filter the solution.

No. 2.	Carbonate of Potash	3 oz.
	Water	4 "
	Dissolve.	
	Sulphite of Soda	2 oz.
	Warm Water	4 "
	Dissolve, mix the two and filter the solution.	

For use, take one dram of each to two ounces of water, and add a few drops more of No. 1, from time to time, to secure desired density. This developer keeps well, and I can recommend it as an excellent one.

Whatever may be said of the good qualities of the pyro, it has the one exceedingly bad quality of staining everything with which

it comes in contact, even to a greater degree than the iron developer. Hydroquinon, on the contrary, is very free from this disagreeable trait, and it was this fact that led me to abandon the former. Hydroquinon is certainly an excellent substitute for pyro; it is cleanly, and when properly prepared it is equally as vigorous as the latter, keeps well, and can be used over and over again by the addition of a little fresh developer, without serious loss of power. I have found that when used with caustic potash it works admirably, and the only thing to be guarded against is its tendency in hot weather to frill the plate. This can be obviated to a great extent by using ice in the developer, and this is an excellent practice to follow during the summer months whenever it can be conveniently done. The best formula I have ever used for hydroquinon is the following:

No. 1.	Hydroquinon	2 dr.
	Sulphite Soda	2 oz.
	Bromide Potash	2½ gr.
	Water	14 oz.
No. 2.	Caustic Potash	45 gr.
	Water	4 oz.

Use four parts of No. 1 to one-half part of No. 2.

And if I were allowed but one developer for the rest of my photographic life, I should choose one containing hydroquinon. At present I am using, or rather I have in stock ready to use, a developer made of eikonogen and soda in the following proportions:

No. 1.	Water (distilled)	18 oz.
	Sulphite Soda (S. S.)	3½ "
	Dissolve; Add Eikonogen	180 gr.
No. 2.	Water (distilled)	18 oz.
	Carbonate Soda	1½ "
	Carbonate Potash	1 "

Use three parts of No. 1 to one part of No. 2.

So far I have not had an opportunity to thoroughly demonstrate what it will do, and therefore I can not speak of it as fully as I could wish. It seems to be a very fair developer, equally good for bromide paper and for transparencies, as well as for dry plates, but I have not found it would answer for opals, for the reason that it discolors the film. It may be that a remedy for this can be found, but, as stated before, I have not worked with it sufficiently long to learn all its possibilities.

One great cause of failure among amateurs I think comes from a lack of knowledge when to cease development, and that too when exposure is pretty nearly correct. In this matter, as in the matter of exposures, no hard and fast rule can be laid down, by which success will be assured. Different makes of plates present different appearances at the same stage of development, so I would recommend that one brand of plates be used as exclusively as possible. I know of no better way of learning when a plate has been sufficiently developed, than to make an exposure on a row of buildings all alike, let them cover the ground glass from one side to the other. After inserting your holder, draw the slide out, say one-quarter of its length, uncap your lens, and give, say, two seconds exposure; recap the lens and draw your slide again, this time half way out, uncap and expose for another two seconds; repeat this operation again, draw the slide out three-fourths of its length, exposing it as before, and again draw it entirely out, giving the same exposure. The first quarter of the plate will then have eight seconds exposure, the second quarter six seconds exposure, the third quarter four seconds exposure, and the last two seconds exposure. Develop this plate with your normal developer until in the center of the plate you find you have plenty of detail in the shadows, with sufficient density; wash thoroughly, fix and dry; you will now have a plate which in all probability is in one part under-exposed, and in another part about correctly exposed, and in another part over-exposed, and consequently you have an illustration of under-development, correct development, and over-development. Make a print from this, then sit down and study both print and negative. The under-exposed part will present a lack of detail in the shadows and a thin, transparent negative. Over-exposure will be shown by an abundance of detail, but a plate thin with a general foggy appearance. The over-developed portion will show detail all out, but too dense and strong, while the under-developed will show a clear but weak negative, with considerable detail, which would have been improved by longer development.

It is oftentimes a difficult matter to tell whether a plate has been over-exposed or under-developed, but as a rule I think amateurs are more apt to err on the side of over-exposure, rather than under-development. Now if you will make three or four exposures at the same time and under the same conditions as this one was made,

cut your plate in quarters, being careful to so mark each part that you can tell its length of exposure and develop each part separately, adding a trifle more of the alkali to the developer for the under-exposed parts, remembering that it is a very easy matter to produce a chemical fog by the injudicious use of the alkali—adding a few drops of the solution of bromide of potassium, or an ounce or two of water, when you develop the over-exposed part, and when you find your negative has plenty of detail but little density, add a trifle more of the acid solution, you will soon learn the possibilities of your developer, and in time become complete master of this branch of photography. Remember, however, that first and foremost is correct exposure, for while it is true that an over-exposed plate may be so doctored as to give a fairly good printing negative, it is impossible to bring out on a plate that which the light has failed to place there; therefore, devote your best endeavors to securing the proper light and giving the proper time to the plate when you uncap your lens.

I well remember once upon a photographic tour, when at some distance from this city, and about to make my exposure, my lens cap fell from my hand and rolled over a cliff some hundred feet or more into the river beneath my feet. I was fortunate enough when I returned to the hotel where I was stopping, to procure from the medicine chest of the proprietor an empty pill-box, the cover of which fitted the hood of my lens perfectly. After blacking the inside of it with ink, I started out the next morning a good deal discouraged with the wretched quality of the negatives I had been making, and vowing vengeance upon the manufacturer of the poor plates I had been using. As I stood with my pill-box cap, studying what stop I should use—just before making my first exposure, my eye fell upon the direction written upon the pill-box lid, which had hitherto quite escaped my observation; it read as follows: *Take one every two hours.* It flashed across my mind that this injunction was as applicable to my case as it was to the person for whom the pills were intended, and that the doctor had unconsciously written wiser than he knew. I had been taking pictures (so called), at the rate of one every fifteen minutes, as long as my plates held out. Now here was an injunction to take one every two hours only—I obeyed the directions implicitly—I waited for my light, chose my position, thought about my subject, and that night before retiring I had the satisfaction of knowing I

had four or five of the best negatives that I had ever been able to turn out. I think that every amateur photographer, at the beginning of his career, ought to write upon the cap of his lens, these magical words : "Take one every two hours ;" and if he will act upon them, it will not be long before he will find that development is only of secondary importance, and that a well-timed plate in a normal developer will pretty nearly develop itself.

A very prolonged development is almost sure to produce a chemical fog, and when I can not get a good result from a plate in ten minutes manipulation, I am ready to throw it to one side and acknowledge the failure. Usually a plate will be fully developed in five minutes, and even in less time, unless your developer is extremely weak. Much has been said about the development of an instantaneous exposure, some contending for a strong developer from the first, and others for a weak developer to begin with, and gradually strengthen until it has reached the proportions of the normal. For my part I have made very few satisfactory negatives where the exposure has been less than one-tenth of a second, but what few I have got have been made with a normal developer. If the image is upon the plate, a normal developer ought to bring it out, and if it is not there it can not be coaxed out with a weak developer, or forced out with a strong one.

The bane of an amateur photographer's existence is the constant changing from one developer to another or from one formula to another, before he has mastered any. My advice to beginners is, not to try to find the best developer there is, for you will never succeed. A much better plan is to take some good developer (and every manufacturer of plates sends a good formula with each box), and experiment with it upon plates under-exposed, correctly exposed, and over-exposed—that is, if you must experiment—until you learn it thoroughly, and then stick to it. You will succeed better with an inferior developer handled intelligently, than with a much better developer handled in ignorance.

Now in connection with the subject of development, let me say a few words about the intensification of the negative, although it does not properly belong to the subject of dry plate development. It sometimes happens that owing to over-exposure a plate has a flat, dead look, with no contrast between the lights and shadows; the detail is all out, and if it were not for this lack of contrast the negative would be a satisfactory one. This defect may be corrected

(I do not say it will be corrected, for intensification is an extremely hazardous operation and should be rarely practiced) by first washing the plate thoroughly so that all traces of hypo are eliminated —be particular about this—and then immerse the plate in a saturated solution of bichloride of mercury which has previously been filtered through absorbent cotton or filter paper, so as to prevent any particles of undissolved mercury from coming in contact with the film, for if allowed to remain in contact with the gelatine it attacks the film with great energy, producing minute pin-holes in it. Always keep the solution moving as you would the developer, and watch closely for any particles of undissolved mercury, which will sometimes form in the saturated solution even after it has been strained. Should any adhere to the film, remove it at once with the finger, and keep the solution moving so that it will not again have a chance to settle in any one spot; in a few moments you will observe the edges of the plate assume a grayish color, which gradually extends to the center, and continues to grow whiter until at length you get a positive effect on the plate. The degree to which intensification should be carried, can only be determined by the condition of the plate, but it rarely should be carried beyond the point where the plate is gray all over—or when you have observed a positive effect all over it—remove it at once from the bichloride solution and wash thoroughly, then immerse it in a weak solution of ammonia (about ten drops to an ounce of water); as soon as the grayish color before spoken of has changed to dark brown, remove it from the ammonia solution and wash thoroughly, and if upon examination by transmitted light there does not appear to be sufficient density, it may be again immersed in the ammonia solution and kept there until it has become black instead of brown; but I have never found any advantage in returning the plate the second time to the bichloride solution; others may have been more fortunate, but my experience is, that having once gone through the ammonia solution, the bichloride solution has no further effect on it. Be very careful to pour the bichloride solution upon the plate gently, for if dashed upon it the solution appears to penetrate the gelatine at the point of impact, and after the final washing is complete you will find the negative much denser at that point than anywhere else, and you will have to resort to local reduction to get an even intensification all over the plate. This is an extremely delicate matter to perform, and hardly worth describing here.

To the subject of development there seems to be no limit; not so, however, with the subject of a dark room; with the former much is to be taken on faith, to be accepted or rejected as the circumstances afterward seem to warrant; but with the latter it is open as the air, and with a very small modicum of common sense, and at an equally small expense, a dark room may be constructed which will answer every purpose of the amateur. Some of the best negatives I have ever made were developed on the banks of a river with no shelter above my head, nothing but a barrel stave laid across a couple of logs for a table, and an ordinary lantern covered with ruby fabric or yellow post-office paper for my light —the light which escaped from the top of the lantern extending upward and doing no harm, as there was nothing to reflect it back again upon the plate. Of course, a dark room can be constructed having all the modern conveniences for washing, etc. But the requisites are not many, consisting mainly of non-actinic light, and an unlimited supply of cold, clear water. The term "dark room" does not necessarily mean a room totally dark by any means; it may be far from dark, only let the light which comes in be of a low actinic character. Of course, no light is absolutely non-actinic, but the actinic rays may be so nearly eliminated as to render the light practically harmless, and yet the room may be so light that objects can be distinctly seen. If one can arrange it so that the light can enter from the outside, it is very much better than to have a lantern in the room where you are at work. This is especially the case if your room is small and the ventilation poor. My own dark room, which is in the cellar, is six feet long and three and a half feet wide, and although I have any number of bottles, boxes, etc., I find it plenty large enough for one person to work in comfortably. From the outside of the house I have a two-inch iron pipe leading to one lower corner of the room, while at the diagonally opposite upper corner a pipe of the same size is connected with the smoke flue of my furnace. This insures me at all times a perfect ventilation. My light is from a gas jet from the outside of my window, but regulated from within by a key, so I can have any desired amount of light in a moment without going out of my room or opening a window. In so small a room space must be economized, and this can be done, and all the shelf room desired can be had, by having such shelves as are constantly in use above the height of one's head, and those not constantly in use

hung on hinges which can be raised when needed and lowered against the wall when not in use. Over my sink I have a goose-neck supply pipe, such as you often see in barber shops and lavatories, but so arranged that when not in use, it may be turned to one side out of the way; to this is attached a rubber tube terminating in a spray similar to the familiar shower-bath arrangement. On this rubber tube and just above the spray I have a piece of lead pipe weighing about one-quarter of a pound, which prevents the tube from becoming unmanageable when the water is turned on in full force, and this weight serves the further purpose of acting as a pendulum, for by giving it a slight motion it will continue to swing for a considerable time and distribute the water over the entire sink, instead of in one place, thereby reducing the danger of breaking the gelatine from the force of the water falling continually in one spot. My sink is of copper, but if I should ever build another dark room I would replace it with a porcelain one, as I find the acids will, in the course of time, eat out the copper and allow the water to leak out upon the floor; this can be prevented in some degree by painting the sink with asphaltum varnish, which the acids do not seem to attack successfully. A porcelain sink is open to the objection that a plate is much more apt to be broken by coming in contact with it, than it would be against a copper one. I have, however, in my sink a wire draining board, such as is sometimes used in the kitchen for draining dishes upon, only mine is about one inch high, and answers admirably for laying plates upon, and does not interfere with the discharge of the water through the waste pipe. My window is glazed with heavy ground glass, to which is attached one thickness of orange colored paper, and one thickness of ruby fabric; this forms a screen sufficiently non-actinic for practical purposes, and yet by turning on the full head of gas I have sufficient light to illuminate the whole room. I have found a double shelf, or rather a shelf with a drawer about one and one-half inches high directly underneath, a very great convenience; but instead of the drawer pulling out underneath the shelf, the front is hung on hinges, and can be let down at pleasure to receive the tray containing the plate in process of development, in case it is found desirable to open up the room and let in white light before the plate is ready to put in the hypo. As I have said before, I find wide mouth bottles very handy in a dark room,

and those having ground glass stoppers are much the best. A passage-way having two doors about three feet or more apart leading into the dark room is better than one door entering directly in, as the two effectually exclude white light, and permit the entrance or exit of any one without the necessity of turning down the light, one door closing before the other is opened. Should you be obliged to use a lantern in a dark room, let the shelf upon which your trays are placed be so large that you can move the light to each tray conveniently and not the trays to the light. If one can not have ventilating pipes, one or two slatted doors very similar to the outside shutters of houses, will allow considerable fresh air to enter, and practically exclude the light. Every well-regulated dark room ought to be provided with a sponge, a scrub-brush and a cake of Sapolio. All trays and graduates should be kept clean and free from dust; a rubber funnel and a box of filtering paper is also very desirable to have. The window should be double, the outside of ground glass, and should slide up and down and not hang upon hinges. Personally I do not take much stock in ruby glass; ruby fabric and orange-colored paper used in conjunction give a much pleasanter light to work by, and are equally as effective in excluding the actinic rays. Label all your bottles; do not mix your developer until you are ready to use it; filter the old developer and keep it to use on over-timed plates, or to start development with when your exposure is doubtful. I have found it very convenient sometimes to be able to distinguish my hypo trays from my developing trays without opening up my room to the light, and as I use the unglazed hard rubber trays, this is easily done by cutting a small notch on all four sides of my hypo trays, so that by simply running my finger along the edge I am unmistakably informed which tray I have in my hand.

Sometimes a fine camel's-hair brush is used with which to dust off plates before putting them in the holders, but as this is stated to cause a slight electrical disturbance, whereby particles of dust are attracted to the plate, it may without detriment be dispensed with, and instead, the plates, after being placed in the holder, may be fanned with the slide before it is returned to the holder; this will remove as effectually any dust that might adhere to the films. Let me caution the younger members not to attempt to dry their plates by artificial heat. A plate that is perfectly dry can stand any

ordinary amount of heat without injury to the gelatine, but a very slight amount of heat will soften the gelatine when it is wet and cause it to run from the glass. Let your plates dry spontaneously. And I also advise that no attempt be made to hurry the drying by immersing the plate in alcohol, for the purpose of expelling the water from the film. Like many other things you will find advocated in photographic journals, this is a mere make-shift with little real merit in it. It is not worth one's while to risk the spoiling of a day's outing, or endanger some choice negative, by hurrying it through at the end. Let it take its own time to dry, remembering that a good negative is, to change the quotation slightly, a thing of beauty and a joy forever.

IN MEMORIAM—WM. H. GARRATT.

It is a matter to be regretted that the Society has had a benefactor in the late Hon. W. T. Garratt, of the city of San Francisco, whose memory and good works can only be noticed, without the pleasing accessory of something certain of his life history.

It was through the action of Mr. Erastus Gest and Mr. Charles Kilgour that the attention of Mr. Garratt was directed to the Cincinnati Society of Natural History. His interest was thus aroused, and in a most generous way he at once (in 1888) contributed his first fine donation to the Society. Nor did he stop at that; he not only promised and collected for the Society, but actively engaged in search and solicitation among his relic- and curio-collecting friends of the Pacific Coast in our behalf. His second effort resulted in the reception of his last shipment—a pleasing surprise, and most valuable acquisition.

Mr. Garratt, as we are informed, was a native of Waterbury, Conn.: born in the year 1829, October 4th. He spoke in his correspondence of having an abiding affection for Ohio, and the city of Cincinnati, because of early associations, from which, probably, was partly due his ready willingness and desire to add to the value and attractiveness of our museum. From this it would appear that he commenced his westward travel when but a very young man, and this view is strengthened from what we hear, viz.: that he was of that restless band of brave, adventurous men to cross the plains to California in 1849. There he grew up with the country, was enterprising, industrious and successful as a business man, leaving behind him a large fortune, as well as a name highly honored for every good work.

It was a favorite idea and wish of his to visit the city he remembered with so much affection—and it was the like wish of our Society to greet him here, show him our good work, and thank him for his kindly, open-handed assistance. That "man proposes, but God disposes," is a truth of fact in this instance. We shall never see our friend here. All that is left to us is to cherish his kindly acts and keep his memory green among us.

The Society has testified by its acts a proper appreciation of Mr.

Garratt's gifts. His collections are placed distinctively, and will always be known by the name of "The Garratt Collection." A handsomely engrossed certificate of receipt was sent him, and he was made an honorary member of our Society. We have for a distinct idea of the man, a photograph, from which we learn that our friend was as noble appearing as he was good. This picture it is proposed to have enlarged, framed, and placed on our walls to accompany that of Mr. Bodman, and to become one on the roll of our necrology, to be in sight and honor in future years.

Your committee would recommend that this, their report, be spread upon the minutes of this Society, two pages thereof being set apart therefor, *in memoriam*.

J. Ralston Skinner,
James A. Henshall,
Geo. W. Harper

Cincinnati, March 4, 1890.

LIST OF DONATIONS RECEIVED SINCE JANUARY 1, 1890.

From Wilfred Guild: Rough Stone Implement.

Dr. A. J. Howe: Skin of Rattlesnake; Indian Writing on Birch Bark.

John H. Francis: Hornet's Nest.

Wm. T. Garratt: Bituminous Coal from Behring Strait.

Jacob Hoffner: Skull of Alligator Snapping Turtle.

United States Fish Commission: Recent Crinoid.

H. T. Woodman: Four Specimens of Fossil Coral (polished).

Dr. N. E. Jones: Skin of Barn Owl.

Charles Dury: 1 Copperhead Snake; 5 Grass Snakes; 1 Ring-necked Snake; 1 Ground Lizard; 3 Blue-tailed Lizards; 2 Salamanders; 4 Myriapods; (all from Hamilton County, O.); 3 Horned Toads (New Mexico); 1 Gopher Turtle (Florida); 1 Phalanger skin (Australia); 1 Armadillo skin (South America); 1 Porcupine skin (Africa); and the skins of the following Ohio birds: Canvas-back Duck: Old Squaw; Canada Goose; Merganser; Scoter; Rough-legged Hawk; Ruffed Grouse; Snipe; Golden Plover; Whip-poor-will; Shoveller Duck; and Wild Turkey (Illinois).

G. Frederick Wright: Photo. of the "Nampa Image."

Miss Clara Campbell: Pair of Antique Roman Ox-horns.

Wm. Hubbell Fisher: 2 Opossum skins and skulls.

Dr. O. D. Norton: Indian Medicine Charm.

E. O. Hurd: Gadwall Duck (mounted); Cormorant (mounted); Cormorant Skin (Reelfoot Lake, Tenn.)

BOOKS AND PAMPHLETS.

Wm. Doherty, author: Monogram on "Assam Butterflies."

Hon. J. H. Bates: Jasper's "Birds of North America," complete.

Dr. E. G. Betty: "Tertiary Vertebrata," vol. iii., pt. i.

Dr. O. D. Norton: "Laying Corner Stone Cal. Mus.," (pamphlet); Edw. Hitchcock's "Final Report Geology of Massachusetts, vol. i., 1841.

Chas. E. Beecher, author: "Lingual Dentition of Pyrgula;" "Abnormal Forms of Fresh-water Shells;" "Note on Fossil Spider;" "Branchiospongidæ;" "Development of Some Silurian Brachiopoda."

Hon. Ben. Butterworth: "Third Annual Report Bureau of Animal Industry;" "Fur-seal and Other Fisheries of Alaska;" "Report of Natural History Collection from Alaska, 1877–1881." "Survey of Rocky Mountain Region," Ethnology, vol. v.; "Survey of Territories of Wyoming and Idaho," 1878, pts. 1 and 2; "Bulletin United States Fish Commission;" vol. ii.; "Report of United States Fish Commission," vol. viii.; "Smithsonian Report," 1881; "Catalogue of Government Publications, 1774–1881;" "Consular Report, Cattle and Farming, 1887."

Dr Daniel G. Brinton, author: "Etruscan and Libyan Names;" "Essays of an Americanist;" "Giordano Bruno."

State Board of Health of Tennessee; Bulletins, February, March, April.

Bureau of Ethnology: Fifth and Sixth "Annual Reports;" "Bibl. of Iroquoian Languages," J. C. Pilling; "Bibl. of Muskhogean Languages," J. C. Pilling; "Textile Fabrics of Peru," Wm. H. Holmes; "Circular, Square and Octagonal Earth Works of Ohio," Cyrus Thomas; "The Problem of the Ohio Mounds," Cyrus Thomas.

E. D. Cope, author: "Horned Dinosaurs of the Laramie."

United States War Department: "Monthly Weather Review," current numbers.

Jos. F. James, author: "Section of the Maquoketa Shales in Iowa," 1889.

Illinois State Laboratory of Natural History: "Report on the Animals of the Waters of the Mississippi Bottoms," H. Garman.

United States Fish Commission: Bulletin, vol. vii., 1887.

Bureau of Agriculture: "Report of Trip to Australia."

Dr. Zucchinetti, Cairo, Egypt, author: "Souvenirs de mon Se jour chez Emin Pacha el Soudani."

J. S. Newberry, author: "Rock-salt Deposits of Salina Group in Western New York;" "Memorial of Presidênt F. A. P. Barnard."

Smithsonian Institution: "Annual Reports," 1886, 1887.

P. R. Uhler, author: "New Genera and Species of American Homoptera;" "Additions to Obs. on Cret. and Eocene Formations of Maryland;" "Observations on North American Capsidæ."

Thos. Davidson, author: "Giordano Bruno's Thought."

Bureau of Education: "Rules for a Dictionary Catalogue;" "Honorary Degrees as Conferred in American Colleges;" "History of Federal and State Aid to Higher Education in the United States."

New York Board of Department of Parks: "Report Central Park Menagerie, 1890."

Department of Interior: "Official Catalogue United States Exhibit at Paris Exposition," 1889.

Dr. L. Dorapsky, author: "Los Aguas Minerales de Chile."

THE JOURNAL

OF THE

Cincinnati Society of Natural History

Vol. XIII. CINCINNATI, JULY, 1890. No. 2.

PROCEEDINGS.

ANNUAL MEETING, *April* 1, 1890.

President Fisher in the chair.

There were fifty members present.

The minutes of the January and March meetings were read and approved.

The following were nominated for active membership: George Docker, Everett W. Hobart, Wm. B. Melish, Anton Schroeter, Charles G. Comegys and Rev. J. W. Simpson.

Prof. Joseph Moore, of Richmond, Ind., was nominated for corresponding membership.

The following were elected to active membership: Miss Mary Tatum, W. C. Jirdinston and Dr. P. M. Bigney.

The minutes of the Executive Board for December, January and February were read.

The President then delivered the annual address.

The Secretary read his annual report, from which it appears that during the past year twelve regular meetings and one reception had been held. The average attendance had been twenty-five. Forty-two active members, one life member, one honorary member and one corresponding member had been elected. Two active members had resigned, and one active member, two life members and one honorary member had died during the year.

Forty-two papers were read by title, by abstract, or in full, at the different meetings, and numerous communications had been submitted.

The Ninth Annual Course of Free Popular Scientific Lectures was given at the College of Music Lyceum, with an average attendance of three hundred persons. The lecturers of the Course were as follows:

Prof. Jno. M. Coulter, (Wabash College)—"The Physical Basis of Life."

Pres. J. P. D. John, (DePauw University) — "Our Celestial Visitors."

Mr. Charles Dury, (Cincinnati, O.)—"Famous Birds of Poetry and Song."

Prof. Edward Orton, (Ohio State University)— "The Stored Power of the World."

Prof. Edw. T. Nelson, (Ohio Wesleyan University)—"Left-handed People."

Prof. O. P. Jenkins, (DePauw University) — "The Variant Forms of Fishes."

Pres. D. S. Jordan, (Indiana University)—"The Yellowstone Park."

Dr. Leonard Freeman, (Ohio Medical College)—"Our Microscopic Enemies."

Prof. S. A. Forbes, (State Entomologist, Illinois)—"Entomological Illustrations of Evolution."

Prof. G. Frederick Wright, (Oberlin College)—"The Age of Ice in North America."

The Report of the Treasurer, S. E. Wright, was read by the Secretary, from which it appeared that there had been received during the year from various sources the sum of $4,781.53. There had been expended $3,617.85, and $1,150 had been turned over to the Trustees to invest, showing that the finances of the Society were in a healthy condition.

The Report of the Trustees was read by Mr. Aaron A. Ferris, showing that the securities, notes and bonds in their possession amounted to $42,540.

The Report of the Custodian was read and referred to the Publishing Committee.

The Report of Mr. E. O. Ulrich, Curator of Geology, was then read and ordered filed.

The Curator of Entomology, Mr. Charles Dury, and the Curator of Zoology, Dr. A. J. Howe, reported verbally concerning the condition of their departments, which agreed with and confirmed the report of the Custodian.

Mr. George Bullock, Curator of Photography, reported verbally that the Photographic Section was in a very prosperous condition; was fast increasing in membership, with a growing interest in its

work, and with a large attendance at its meetings. More convenient and commodious quarters were needed.

Mr. J. Ralston Skinner and Mr. Thos. H. Kellogg made statements as to the plans and progress of raising funds for the erection of an addition to the Society's building.

The action of the Executive Board in the matter of the new building was, by vote of the Society, indorsed and concurred in.

Several amendments to the By-Laws were submitted for the action of the Society at its next meeting.

The Annual Election of Officers then took place, with the following result:

President—Col. J. W. Abert.

First Vice-President—George Bullock.

Second Vice-President—Prof. Geo. W. Harper.

Secretary—Dr. James A. Henshall.

Treasurer—Davis L. James.

Trustee—Aaron A. Ferris.

Members-at-Large of Executive Board—J. Ralston Skinner, A. Denniston Smith, E. J. Carpenter and Thos. H. Kelley.

Librarian—Wm. H. Knight.

Curator of Geology—E. O. Ulrich.

Curator of Botany—Charles J. Herrick.

Curator of Zoology—Charles Dury.

Curator of Photography—T. B. Collier.

Curator of Microscopy—George B. Twichell.

Curator of Physics—Dr. A. J. Howe.

Curator of Chemistry—Dr. W. S. Christopher.

Adjourned.

Regular Meeting, *May* 6, 1890.

President Abert in the chair.

There were twenty-two members present.

The minutes of the last meeting were read and approved.

The following persons were elected to active membership: Everett W. Hobart, Wm. B. Melish, George Docker, Chas. G. Comegys, Anton Schroeter and Rev. J. W. Simpson.

Prof. Joseph Moore was elected a corresponding member.

The following were proposed for active membership: Col. L. C. Weir, Judge S. N. Maxwell and G. O. Rinman.

The minutes of the Executive Board for March were read.

The Committees appointed to examine the reports and accounts of the Treasurer and Trustees reported that the same were found correct.

Several amendments to the By-Laws, in regard to the duties of the Secretary and Treasurer, and changing the title of "Custodian" to "Director of the Museum," were adopted.

Dr. Henshall rend by title two papers, entitled: "A Cave in the Clinton Formation of Ohio," by Prof. Jos. F. James; and "Description of Some New Genera and Species of Echinodermata, from the Coal Measures and Subcarboniferous Rocks of Indiana, Missouri and Iowa," by S. A. Miller and Wm. F. E. Gurley.

Adjourned.

REGULAR MEETING, *June* 3, 1890.

President Abert in the chair.

The minutes of the last meeting were read and approved.

Under a suspension of the rules all of the following were elected to membership:

Active members—Percy Wells, Prof. Alois Schmidt, Chas. J. Iredell, Frank L. Mills, L. H. Meakin, Wm. A. Haven, Joseph Green, Carl Lukenheimer, Paul Gillespie, Julian Wright, Dr. H. T. Smith, Isaac M. Jordan, Jr., Chas. J. Jennings, Chas. Fleishman, Jos. C. Wright, J. W. Dennison, Edw. Cook, E. F. Rychen, C. Stowe Reno, W. M. Smith, L. C. Weir, S. N. Maxwell and G. O. Rinman.

Life members— ——— Hannaford and Ralph T. Kellogg.

The resignations of Miss Susan Griffith, Miss Emily Hopkins and Omer T. Joslin were accepted.

Mr. Chas. Dury read a paper "On the Occurrence of the Little Black Rail (Porzana jamaicensis) in Ohio," and showed a specimen shot near Cincinnati.

The Secretary was authorized to investigate some reputed exhumations of Indian skeletons and relics at Lawrenceburg, Indiana.

Mr. J. Ralston Skinner gave a very interesting lecture on the "Construction of the Alphabet," illustrated by diagrams and lantern-slides.

Adjourned.

LIST OF DONATIONS RECEIVED SINCE APRIL 1, 1890.

Miss Jennie Hill: Specimens of Petrified Wood and Iron Ore, Texas; 1 Centipede, Harrison County, Texas.

Henry Oskamp: 2 Large Specimens Petrified Wood, Wyoming Territory.

Dr. A. E. Heighway: Staurolites, Fannin County, Ga.; Amethyst Crystals, Macon County, N. C.

U. S. Fish Commission: Collection of Florida Fishes, comprising 60 Species, being part of Dr. Henshall's Collection, 1889-90.

Smithsonian Institution: Collection of Marine Invertebrates, comprising 93 Species.

Anton Schroeter: Fossil Fern, Ashland, Ky.

Alfred Nippert: 5 Volumes Lepidoptera, being the impressions of each side of the wings, whereby the scales and the natural coloration are permanently impressed and preserved upon the pages, comprising several hundred species correctly named.

BOOKS AND PAMPHLETS.

National Acad. Sciences: Vol. IV., Memoir 10.

Fishery Association, Wurtzburg, Germany: Report for 1890.

U. S. Department of Agriculture: Bibliography American Economic Entomology.

Zoological Society, Philadelphia: 18th Annual Report, 1890.

U. Hoepli, Milan, Italy: Catalogue, No. 64, Conchology, 1890.

Felix C. Dames, Berlin: Catalogue, No. 10, Bibl. Entomologica, 1890.

Alex Stuer, Paris: Price-list, Museum Supplies, 1890.

Ohio State University: Catalogue, 1889-90.

Gen. J. D. Cox: A Memorial of Joseph Henry, 1880.

Gustave F. Dollfus, author: Cœlenteres; Bryozonaires; Crustaces Inferieurs.

Hon. Ben. Butterworth: Fisheries Industries of United States, Sec. III. and IV.; Sec. V., Vols. I. and II. and Plates.

Deutschen Wissenschaftlichen Vereins, Mexico: Mittheilungen, Band I., Heft 1.

E. Dufossee, Paris: Catalogue, Series VI., Nos. 7–12.

Societe Royale de Geographie d'Anvers: Le Colorado, 1890.

CUSTODIAN'S REPORT.

CINCINNATI, April 1, 1890.

To the Cincinnati Society of Natural History:

Since my appointment as Custodian, a few weeks ago, in place of Mr. H. P. Smith, resigned, I have carefully looked through the collections in the Museum, and find them in the various conditions of good, bad and indifferent. I found that, owing to the badly-fitting doors in a number of the exhibition cases, and to a lack of proper care, that their contents were more or less injured by dust, smoke and soot; and especially was this the case in regard to the collection of bird-skins, which were exposed in badly fitting drawers without protective covering, and as a consequence the skins were badly stained and discolored, in most instances beyond the reach of restoration.

The museum pests, as moths, dermestes, etc., had also been getting in their nefarious and destructive work, and had done some damage. I have had all of the bird and mammal skins taken out and carefully looked over, the drawers thoroughly cleaned, and the skins replaced and covered with canton-flannel, and the drawers and cabinets thoroughly fumigated and disinfected with camphor, naphthaline and carbolic acid. They are now entirely protected from smoke, dust and soot.

I also found the insects in anything but a good condition. The Curator of Entomology, Mr. Dury, kindly went over the "Huntington Collection" of insects with me. We found evidences of the work of the dermestes in nearly every box. Many rare specimens had been also damaged through careless handling, by having the antennæ and legs broken off. We removed and destroyed those that seemed to be infected with pests, and those that had been utterly ruined. I have thoroughly disinfected the cases, and have put them away where they can not be handled, and hope that no more destruction may ensue. As soon as possible I intend to remove all the insects to the small hall-room on the second floor, and fit a tight door to the room, so that it can be, in a manner, hermetically sealed, thoroughly and effectively fumigated

and disinfected, and in this manner preserve this important collection from the ravages of museum pests.

I have also had strips of listing placed wherever possible in the doors of the large exhibition cases, to exclude dust and soot. All of these cases have likewise been thoroughly fumigated with camphor, naphthaline and crude carbolic acid.

I have begun the work of relabeling the specimens in a manner so that they can be read and understood by visitors, with the least possible fatigue to the eyes. Many of the specimens were wrongly labeled in regard to scientific names, which I have corrected so far as I have gone. As an example of this work, I would ask your attention to the large case of mammals on the second floor, next to the front of the building.

I find that there has been but little or no attempt at a proper classification of the zoological specimens in the cases, owing doubtless to a lack of room; this feature, however, can receive the attention it deserves when the contemplated new addition to our building is erected, and for this reason I shall not attempt to make any radical change for the present in the arrangement of the specimens, though a few necessary changes can, and will be, made at once. My principal care for the present will be given to the preservation of the specimens, and to their thorough and constant disinfection, and to their proper and correct labeling.

I am under obligations to Mr. E. O. Ulrich, Curator of Geology, who has kindly verified and corrected the labels of the fossils of the Cincinnati Group.

There have been many valuable and desirable additions to the Museum during the past year, among which may be mentioned the "Garratt Collection" of Ethnology and Mineralogy; a number of mounted mammals and birds and alcoholic specimens of reptiles and batrachians from Mr. Charles Dury; a pair of mounted antique Roman horns from Miss Clara Campbell, etc. The following members have also donated various specimens to the Museum during the past year: Wm. Hubbell Fisher, E. O. Hurd, Robt. Clarke, Dr. J. A. Henshall, Herbert Jenney, Dr. O. D. Norton, Dr. A. E. Heighway, E. B. Johnson, Dr. R. S. Michel, Dr. A. J. Howe, and Dr. N. E Jones.

From others, not members of the Society, as follows: C. P. Yeatman, Dr. C. H. Ware, Mrs. Henshall, Arthur Whitney, O. P. Hamar, Dr. C. G. Curtis, W. H. Wyman, Willie Jones, Direct-

ors of Zoological Garden, U. S. National Museum, Miss Julia Akerly, Walter Crane, C. G. Lloyd, Big Four Railroad, Dr. A. B. Carnahan, H. A. Smith, Wilfred Guild, Mr. Francis, Jacob Hoffner, U. S. Fish Commission, H. T. Woodman, Prof. G. F. Wright and P. D. Breed.

In response to my personal application, the United States Fish Commission is now making up a large and fine collection of marine invertebrates, to be forwarded as soon as we have room for them. This fine donation will be furnished entirely free of all expense to the Society.

I have also added a number of species and many examples to the collection of Ohio fishes and reptiles and batrachians, so that we now have nearly all the fishes, and a good beginning for the collection of Ohio reptiles and amphibians.

I am daily expecting a series of Florida fishes, being part of the collection I obtained last winter for the United States Fish Commission, a gift from that institution.

I shall at once begin to make a permanent catalogue, museum registers and accession lists of all the specimens in the collections, with card catalogues to correspond as indices to the same.

During the year there have been two new book-cases added to the library, so that there is now ample room for our extensive collection of books. A new arrangement and proper classification of the books is much needed, and should be done when the new library room is completed. You are referred to the last number of the JOURNAL for a list of the books added during the year; as an addendum to that list, however, I will mention donations from the following persons: Dr. O. D. Norton, Wm. Doherty, E. D. Cope, Dr. E. G. Betty, Chas. E. Beecher, Hon. Ben Butterworth, U. S. War Department, Dr. A. G. Brinton, State Board of Health of Tennessee, Bureau of Ethnology, S. A. Forbes, United States Fish Commission, Bureau of Agriculture, Dr. Zucchinetti, J. S. Newberry, the Smithsonian Institution.

Respectfully submitted, J. A. HENSHALL,
Custodian.

REPORT OF CURATOR OF GEOLOGY.

CINCINNATI, April 1, 1890.

To the Cincinnati Society of Natural History:

The Curator of the Geological Department has to report:

That the Society's collections in this branch or branches of science have not been materially added to during the past year. Indeed, no effort was made to secure new material, since the space and cases allotted to the department are insufficient for the proper display of the collections already owned by the Society. It is hoped and recommended that when the contemplated addition to the building has been completed, that more room and cases may be placed at the disposal of this important department.

The Curator is now engaged at reclassifying and relabeling the fossils. This is no small task, since great confusion exists among the specimens, making it necessary that each and every one should be subjected to careful examination.

When this work is finished the Society will have lost a few species, but these will be more than balanced by a number not heretofore recognized.

It should also be mentioned that a geological section has been organized, holding informal sessions at the Society's rooms every Saturday afternoon.

Respectfully submitted,

E. O. ULRICH, Curator.

CONSTITUTION AND BY-LAWS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY.

(As revised and adopted March 4, 1890.)*

ARTICLE I.

This Society shall be called the Cincinnati Society of Natural History.

ARTICLE II.

Its objects shall be: To investigate Natural History; to carry on observations which tend to increase the sum of Scientific Knowledge; to establish a Public Museum and a Scientific Library; and to promote the diffusion of Science.

ARTICLE III.

It shall consist of the following classes of members: First, Patrons; second, Fellows; third, Life members; fourth, Active members; fifth, Honorary members; sixth, Corresponding members.

ARTICLE IV.

SECTION 1. Any person shall be eligible as an active member of the Society. All classes of members shall be elected by ballot, after having been nominated at a preceding meeting. The affirmative votes of three-fourths of the members present shall be necessary to a choice.

SECTION 2. The contribution of $1,000 or more to the funds of

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*At the meeting of the Society on June 4, 1889, a committee of five was ordered to be appointed by the President to revise the Constitution and By-Laws of the Society. The said Committee was subsequently appointed by the President, and after several meetings its report was submitted and the revised Constitution and By-Laws read for the first time at the regular meeting of the Society on January 7, 1890. At the meeting on February 4, 1890, the revised Constitution and By-Laws were again read, amended and adopted *seriatim*. At the meeting on March 4, 1890, the said revised Constitution and By-Laws were again read, amended and adopted *seriatim*, and as a whole, as the Constitution and By-Laws of the Society. The Committee was composed of Dr. J. A. Henshall, Davis L. James, Geo. W. Harper, J. Ralston Skinner, and Aaron A. Ferris.

the Society, at any one time, shall entitle the person giving the same to be a Patron of the Society, who shall have the right in perpetuity to appoint the successor in such patronship.

The contribution of $500, at one time, shall entitle the person giving the same to be a Fellow of the Society, who shall have the right to appoint one successor in such fellowship.

No appointment of a successor shall be valid unless the same shall be in writing, endorsed on the certificate, or by last will and testament. And the appointment of such successor, in either case, shall be subject to the approval of the Society, as in the election of members.

SECTION 3. Any person contributing fifty dollars at one time to the funds of the Society, shall be entitled to become a Life member, free from assessment.

SECTION 4. Any Active member who has not been in arrears for the term of twenty years, becomes a Life member without further payment. Any Active member who has not been in arrears for a term of ten years, may become a Life member on the payment of twenty-five dollars, and be exempt from further assessment.

ARTICLE V.

All members, except Honorary and Corresponding members, shall be entitled to vote and hold office.

ARTICLE VI.

SECTION 1. The officers of the Society shall be, a President, two Vice-Presidents, a Secretary, a Treasurer, a Librarian, Curators, and four members elected at large for the Executive Board. They shall be elected annually, at the meeting in April, and shall hold office for the term of one year, or until their successors are duly elected. Two Trustees shall also be elected, as provided for in Section 3 of this Article. All officers shall be chosen by ballot, and a majority of the votes cast shall be necessary to a choice.

SECTION 2. The President, two Vice-Presidents, Secretary and Treasurer, and the four members elected at large for the Executive Board, shall together constitute a Board for the management of the concerns of the Society not otherwise provided for in this Constitution, and be called the Executive Board. Five members of this Board shall be a quorum, for the transaction of business.

SECTION 3. The terms of office of the two Trustees shall over-

lap, so that but one Trustee shall be elected at each annual meeting, and shall hold his office for two years.

The Trustees shall be intrusted with, and have charge of, all funded property of the Society, with power to sell and re-invest according to their judgment. Bonds shall be required of these Trustees in such sums, and with such sureties, as may be satisfactory to the Executive Board.

The net income from said funded property shall be paid over by said Trustees to the Treasurer of the Society, on the written order of said Treasurer, approved by the President of the Society.

Section 4. In case of a vacancy by resignation, removal or death, in any of the offices provided for by Section 1 of this Article, the office or offices so vacated shall be filled by the Society at a regular meeting, notice having first been given of such vacancy.

Article VII.

By-laws for the more particular regulation of the Society may be adopted, or amended, at any regular meeting by a vote of two-thirds of the members present, notice having been duly given at least one month previous to action on such by-law or amendment.

Article VIII.

This Constitution may be altered or amended in any of the preceding articles by a vote to that effect of three-fourths of the members present at any two consecutive meetings of the Society, the members having first been duly notified by the Secretary of any proposed alteration, but the two articles which immediately follow shall be unalterable.

Article IX.

The consent of every member shall be necessary to a dissolution of the Society. In case of a dissolution the property of the Society shall not be distributed among the members of the Society, but donors may claim and receive such donations as they may have made to the Museum, and the remainder shall be given to some public institution, on such conditions as may then be agreed on, and the faithful performance of such conditions shall be secured by bonds, with sufficient penalties for the non-fulfillment thereof.

Article X.

This Society shall not be merged into, or combined or associated with, any other society, institution or association whatever, but

shall forever remain free, independent and untrammeled, unless by the consent, in writing, of three-fourths of the members, in good standing, of this Society.

BY-LAWS.

Article I.—Members.

Section 1. Candidates for active membership shall sign a printed application for the same, which application shall be approved by the signatures of three active members.

Applications shall be presented at a regular meeting of the Society, and shall be balloted for at the next, or some subsequent regular meeting. An initiation fee of five dollars shall accompany the application, to be returned to the applicant in case of non-election.

Section 2. Honorary members may be selected from persons eminent for their attainments in science, on whom the Society may wish to confer a compliment of respect. Corresponding members shall consist of persons residing at a distance from the city, who may be interested in the study of Natural History, or desirous of promoting the interests of the Society; neither shall be required to pay an initiation fee or make any contribution. The nomination of persons for Honorary or Corresponding members shall be made by the Executive Board to the Society.

Section 3. No person whose application for membership has been rejected, shall be again proposed within one year of the date of said rejection.

Section 4. Any member may withdraw from the Society by presenting his written resignation, and paying all arrearages due from him. Members who shall be in arrears for the dues of one year shall *not* be entitled to vote, hold office or to receive any of the publications of the Society until such arrearages are fully paid; and if not paid within one year thereafter, membership shall be forfeited.

Section 5. Members may be expelled from the Society by a vote of three-fourths of the members present at a regular meeting, written charges having been preferred, a copy of which shall be furnished the accused at least one month previous to such vote, and the accused shall have opportunity to be heard thereon.

Article II.—Assessments.

Section 1. Active members shall be subject to an annual assessment of five dollars, payable on the first Tuesday in April of each year, but no assessment shall be required of any member for the current year in which he is elected.

Section 2. The President and Treasurer together shall be empowered to exempt (*sub silentio*) a member from assessment, when, from peculiar circumstances, they may deem it for the interest of the Society so to do.

Article III.—Officers and Their Duties.

Section 1. The President shall preside at the meetings of the Society, and of the Executive Board, and perform such other duties as usually pertain to the office.

Section 2. The Vice-Presidents shall perform the duties of the President in his absence, in the order of seniority in office.

Section 3. The Secretary shall record and preserve correct minutes of the proceedings of the Society and the Executive Board, in books to be kept for that purpose; shall have the charge of all records belonging to the Society; shall notify members of their election, and committees of their appointment; shall call special meetings when directed by the President; and shall notify all active members of all meetings, and officers of all matters which shall occur at any meeting requiring their action. He shall also conduct the correspondence of the Society, and shall keep a record thereof, shall keep the common seal, acknowledge all donations, and receive and read to the Society all communications addressed to it. He shall collect all fees and assessments and immediately pay the same over to the Treasurer, with a specific and detailed statement of the sources from whence derived. He shall notify members who are in arrears, of their indebtedness to the Society, and report all delinquencies to the Executive Board when required. Bond, with securities, may be required of the Secretary for the faithful discharge of this duty, in such sum as may be deemed satisfactory by the Executive Board.

Section 4. The Treasurer shall have charge of all money or other property of the Society, excepting the Museum and its contents, and excepting also such property as may be placed by the Society or the Executive Board in the hands of the Trustees; he shall also have charge of the net income of the funded property of

the Society, to be paid over to him by the Trustees as hereinbefore provided; he shall pay all accounts against the Society, when the same shall be approved by a vote of the Executive Board; shall keep a correct account of all receipts and expenditures, in books belonging to the Society, and shall at each annual meeting, and at other times when required by the Executive Board, make a detailed report of the same. Bond with sureties may be required of the Treasurer for the faithful discharge of his office, by the Executive Board, in such sum as may be deemed satisfactory by said Board.

SECTION 5. The Librarian shall have charge of the books belonging to the Society, or deposited for its use, and of the publications of the Society; he shall observe and enforce such regulations as the Executive Board shall from time to time make for the use of the books. He shall have charge of the distribution, sale and exchange of the publications of the Society, under the direction of the Executive Board.

SECTION 6. Curators shall be *ex-officio* Chairmen of the Sections, in their respective branches of Science. There may be one Curator for each of the following-named branches: Geology; Botany; Zoology; Anthropology; Photography; Microscopy; Physics; Chemistry. The Curators of Geology and Zoology shall have the power to appoint sub-curators in their respective departments.

SECTION 7. The Executive Board shall have full power to act for the interests of the Society in any way not inconsistent with the Constitution and By-Laws. It shall control all expenditures of money, make rules for the use of the Library and Museum, and determine the duties of Curators. It shall have power to employ a Director of the Museum and his assistants, and prescribe their duties, provided they shall not be employed for any term which shall interfere with their discharge at any time by the Board. It shall elect annually a committee of five members of the Society, to be called the Publishing Committee, and shall elect annually a committee of three active members of the Society to be called the Lecture Committee. It shall annually report to the Society the condition of the Museum and Library.

ARTICLE IV.—LIBRARY.

SECTION 1. All members of the Society shall have access to, or take such books from the Library as shall be set apart for circulation. The Executive Board may, by special vote, extend the use

of such books to others than members, specifying the conditions under which they may be taken.

SECTION 2. The rules and regulations of the Executive Board, for the use of the Library, shall be printed and exposed in the Library Rooms, and a digest of them affixed to the volumes themselves.

ARTICLE V.—MUSEUM.

SECTION 1. All members, and the public generally, shall have access to the Museum, at such times as the Executive Board shall determine.

SECTION 2. No specimen shall be removed from the Museum, except by order of the Society, or for the purpose of illustrating the proceedings, and in either case the Director of the Museum shall take a receipt for the same.

ARTICLE VI.—COMMITTEES.

SECTION 1. The Committee on Publication shall, from time to time, cause to be published, and superintend the publication of, such papers read to the Society, and such portions of the record of the proceedings, as may seem to them calculated to promote the interests of Science, so far as the funds appropriated by the Executive Board shall permit. But all papers, before being printed, shall first be read before the Society, either in full, by abstract, or by title.

SECTION 2. The Committee on Lectures shall make arrangements for series or courses of Lectures.

SECTION 3. The President shall, at every annual meeting, appoint a committee of three, whose duty it shall be to audit the accounts of the receipts and expenditures of the Society.

ARTICLE VII.—SECTIONS.

SECTION 1. For the purpose of facilitating and encouraging special investigation in the several branches of Natural Science, the members may organize Sections under the chairmanship of the Curator of the special branch for which the Section is organized, upon the following conditions:

First. Such Sections must be composed only of members of the Society.

Second. They must comply with all the provisions of the Constitution of the Society.

Third. They may organize under a constitution and by-laws of their own, and elect their officers, except the chairman, who is elected by the Society.

Fourth. Being an educational institution, the Society prohibits any section from engaging in anything for money profit.

Article VIII.—Meetings.

Section 1. The regular meetings of the Society shall be held on the first Tuesday of each month, unless the same occurs on a legal holiday or on the day of the State election, when the meeting shall be held on the following Tuesday. The April meeting shall be known as the Annual Meeting, at which the President shall deliver an address, the officers shall read their reports, and the officers of the Society shall be elected.

Section 2. Nine members shall constitute a quorum for the transaction of business.

Section 3. The order of proceeding at meetings, unless otherwise ordered by a vote of two-thirds of the members present, shall be as follows:

1. Reading of Minutes of preceding meeting.
2. Candidates for membership to be proposed.
3. Election of members.
4. Reading the Minutes of the Executive Board.
5. Unfinished business.
6. Miscellaneous business.
7. Scientific written and verbal communications.
8. Donations.
9. Adjournment.

Section 4. Receptions for the members and invited guests may be given under the auspices of the Society.

LIST OF MEMBERS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY.

ACTIVE MEMBERS.

Abert, Col. Jas. W.,
Aldrich, T. H.,
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Anderson, Larz, Jr.,
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Armstrong, M. Louise,
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Beebe, Dr. B. F.,
Bell, John E.,
Berry, A. S.,
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Brown, Anna M.,
Brown, Harry W.,
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Burnet, Margaret,
Burnet, Wm. S.,
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Collins, Jas. A.,
Colter, Dr. Leroy S.,
Comegys, Chas. G.,
Conner, Dr. P. S.,
Cook, Edw.,
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Cooper, E. M.,
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Dawson, Dr. W. W.,
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Devereux, Louise,
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Fagin, H. S.,
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Frank, Laura J.,
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Gamble, Wm. A.,
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THE INDIANS OF NORTH AMERICA.

By Col. James W. Abert.

[Read before the Young People's "Lyceum" March 1, 1890.]

In treating of this people I will arrange the subject under different heads, and will speak of their origin, habits and character.

First of their origin; and in this matter we shall speak of their physiology, language and traditions.

We will divide the races of men into three classes—the white, the red and the black.

Our Indians evidently belong to the red race. Humboldt, Morton and other savants classify them with the Mongolians, who have high cheek bones, narrow and sloping eyes, large ears, big mouths, low foreheads, straight, black and coarse hair, and mongolain shaped skulls.

Humboldt says "that the analogy between the Mongul and the American races is particularly evident."

Animals vary in complexion and color in the various climates. The Arctic Esquimaux is of white complexion, the tropical Creeks and Seminoles of the Floridas are nearly black. The furs and feathers of the brown races of animals become white at the north.

A similar race to our Esquimaux live on the west side of Behring Strait, which is thirty-six miles across, having islands midway. A solid bridge of ice is formed across in winter, so that emigrations from Asia are rendered of easy accomplishment, and the inducements of hunting and fishing must often have led men to traverse the narrow straits, or prevailing winds may have forced them to the eastern coast from the Asiatic shores.

The expression of the red man is fixed, grave and stern. This is referable to moral causes, for where the mind is not cultivated, and where the emotions of the soul have no scope, the physiognomy must reflect the inner dullness of intellect that animates the race.

They have very little beard, and some have the practice of pulling out their eyebrows and even their eyelashes.

Some nations flatten the head by using flat pieces of board on the tender heads of infants. Others cut the outer edges of the ear

loose and attach heavy ornaments thereto—and some perforate the cartilages of the nose, in which they wear rings, reeds, feathers, and other decorations.

The Quiches of Guatemala pierced their ears and lower lips. The natives of Yucatan as well as on the northwestern coast flatten their heads and foreheads by artificial compression.

On the 13th of March, 1848, the famous ethnologist Mr. Albert Gallatin wrote: "Philology is the great and unerring guide by which to ascertain the respective families to which every tribe does belong, * * or, if such be the case, whether it is different from any language previously known to us."

Professor Rafinesque gives the number of original Indian languages in North America as fourteen:

1. *Uskih*, Esquimaux, &c.	8. *Choctaw*, Choctaw, &c.
2. *Onguy*, Wyandot, &c.	9. *Otaly*, Cherokee, &c.
3. *Lenape*, Chippeway, &c.	10. *Atalan*, Tarascan, &c.
4. *Wacash*, N. W. coast, &c.	11. *Otomi*, Otomi, &c.
5. *Skere*, Pawnee, &c.	12. *Aztec*, Mexican, &c.
6. *Nachez*, Natchez, &c.	13. *Maya*, Huesteca, &c.
7. *Capaha*, Sioux, &c.	14. *Chowtal*, Tzendal, &c.

The question most interesting is whether any connection exists between them and those of other people of the earth.

Dr. Barton, of Philadelphia, a great student of languages, said "He thought himself justified to conclude that the original population of America came from Asia."

Du Ponceau stated that the American languages were rich in words, and in grammatical forms, and that order and method prevail.

Also that the forms differ essentially from those of the ancient and modern languages of the Eastern hemisphere.

When Eliot wished to find the Indian word "kneel," he was *forced* to make a word of eleven (11) syllables. All their languages are of long compounded words—*i. e.*, synthetic languages.

Many grammars have been written of our various tribes—among them I would mention that of the Massachusetts, by Eliot, where we find they have all of the nine parts of speech, and various grammatical forms.

In some parts of North America certain words are used by men and others by women for the same things. Acosta relates that

there are some in Mexico who understand each other by whistling —which is ordinarily used among lovers and thieves.

All the tribes possess a knowledge of the universal language of signs, by means of which they engage in long pantomimic conversations.

Signs for animals, as buffalo, deer, elk, and for riding, sleeping, eating, drinking, shooting, raining, snowing, stealing, trading, doubting, lying, are used by Dakota, Comanche, Cheyenne and Crow Indians.

The Natchez Indians had three styles of language—one for the men, another for the women, and a third for ordinary use.

Also the nobility spoke a language partially different from that of the common people.

The people of Greenland, Hudson's Bay and Labrador use, with certain modifications, the language of the Laplanders.

The Indians found by the Spaniards in Mexico and Guatemala asserted that they came at different times from the North, and from the region west of the Rocky Mountains.

The Natchez, who were among the most civilized of the Indians of Florida and Louisiana, state that they came from the region of Mexico, where their chief, or Sun, had his abode; the nation maintained itself against the ancient people of that country, who conquered some of their villages in the plains, but never could force them from the mountains. * * The country on the east side of the large river being extremely pleasant, the 'Great Sun,' upon the return of those he sent to examine it, ordered all his subjects who lived in the plains, and who still defended themselves against the ancients of the country, to remove into this land; here to build a temple and to preserve the eternal fire.

Some of the tribes of this nation were incorporated with the Creeks or Muscogees. Many of the ancient practices of the semi-civilized people of Florida may yet be observed in the institutions of the Creeks.

Many writers agree that, so far as man is concerned, there is no doubt of the one origin of the species. This fact may be proved both physically and morally.

Ledyard says: "I suspect that all red people are of the same family. I am satisfied that America was peopled from Asia, and had some, if not all, its animals from there."

The Chickasaws and Choctaws were met by De Soto on the east

of the Mississippi; they said they came from distant regions to the West.

It is singular how or where many of our Indian tribes obtained their traditions in regard to the deluge, the ark, the dove, with the leaf-twig, the confusion of tongues, or Babel; the descent of the human race from a single pair; of Cain and Abel; their custom of erecting and carving the cross, and the ceremonials of baptism and the holy sacrament. Herrera states that baptism was practiced in Yucatan, and it there signified to be born again. The Mexicans made their principal deity of flour, blood and spices, which after a mimic sacrifice, was broken in pieces, distributed as a communion among the people, who ate it with religious devotion.

We will now speak of their moral and social state, and of the leading features of their government, religion, wars, mechanical arts, etc.

To procure food, raiment and shelter, and undoubtedly these were first necessities of mankind, the weakness of human nature inclines them to fall under the rule of superstition, and the stimulus of pride or oppression excites them to war. We ourselves obtained the names of our days from our ancient pagan ancestors: from Sun, Moon, Thor, Woden, Friga, and the names of our months from the Etruscans. Our Christmas fires of yule-logs, and cakes, are vestiges of the fires of Baal; and the May-pole, of the garden god, Priapus. Our own customs are stamped with the inheritance of superstition.

Some of our Indians—those of the temperate and southern lands—were in a semi-civilized state, as the Natchez, Floridians, Mexicans and Guatemalas.

Most of our American tribes had no fixed abodes. They were dependent for food on fish, and shell fish principally, and huge deposits of mussel and oyster shells mark their localities of sojourning. The buffalo were most plentiful from the District of Columbia to the Rocky Mountains, and supplied them with food, clothing, utensils, ropes, twine, thread, and tents. Their bones were made into bows, hatchets, knives, awls, etc. Their houses were formed by making a frame-work of saplings, which was covered with sheets of bark, skins, mats, and thatching of grass. The center of this roof has a hole for the smoke to escape—for the fire was made in the middle of the floor, and a mat or skin closed up the door.

Many tribes formed a conical structure of poles, which was covered with skins, and were easily transported from place to place, according to the scarcity of game, or to seek the forests in winter to obtain better shelter and fuel. Some lived in caves in the rocks or earth, while the Esquimaux built their huts of frozen snow. Columbus describes certain Indians on the coast of Viragua who lived high up in trees. Huts have been found in Florida, and ruins of huts in the swamps that margin Delaware Bay, which were built similar to those of the Lake Dwellers of Switzerland. Lewis and Clark found on the river banks of the Pacific Slope dwellings two hundred and sixty feet long by thirty wide, in which several families resided; and, on the northwest coast they had skill enough to make planks which were ten feet long, two and a-half broad, and two inches thick; their tools were of bone or stone.

Captain Cook speaks of houses in Nortka Sound built of long, broad plank; and Marchand met with houses two stories high, fifty feet long, thirty-five feet broad, and fifteen feet in height, one story being under ground.

They generally lived on the spontaneous vegetable products of the country: fruits, berries, grass, seed, nuts, roots; also on moss from the rocks, and, in the south, on cocoanuts, plantains and bananas.

The plant most cultivated was the Indian corn, "zea mays;" and toward the south, the root of the yucca and pulque plant.

The Indians also planted beans, peas, several varieties of the gourd family, as pumpkins, squashes, cimblins, watermelons, sunflower seed, and the sweet potato was raised as far north as Maryland. In the south, and West India Islands, they cultivated yams; in Mexico, mezquite beans, tomatoes, peppers, chocolate. The Indians of New Mexico made drink and sugar of the cactus pears, and ate the fruit. Sugar was made of the sap of the sugar maple, box-elder, and from the stalks of the Indian corn. Tobacco was raised wherever the climate was suitable.

Of animal food they partook most freely, eating every kind, even insects, rats, ground-squirrels, snakes, lizards. The meat of buffalo, bear, deer, beaver, etc., was preserved by kindling fires under scaffolds of poles, to be dried and partially smoked. On the northwest coast they ate sea-dogs, cuttle-fish, sea-weeds, train-oil, etc.

Their garments were made of furs, skins, fibrous bark of plants

and of cotton. Among the Six Nations they used the silky fibre from the pods of the milk-weed. The Virginia Indians wore mantles made of feathers. They wove garments of vegetable fibre, of wool, of hair, on very rude looms, and made fine rugs and blankets, using the hair of the buffalo, wolf, lynx and rabbit. In Mexico the women used the distaff, twisting the threads by hand, which were then woven in a loom.

In summer they wore little else than the "breech-cloth," but they generally wore a shirt, fringed leggins, moccasins of deer hide, with a furred mantle over their shoulders which served as bed and bed covering at night. In snowy climates they wore two long frames, like tennis rackets, on their feet, which were called snowshoes, which enabled them to glide over the surface of the snow.

They decorated their dresses with beads of clam-shell, teeth of deer and claws of bear, with porcupine quills dyed in brilliant colors—blue, red and yellow—with chunks of native copper, and mussel-shell pearls; also furs, and feathers of birds; and many tribes wore hoods over their heads.

With sharp stones, bones and shells they made canoes, troughs, bowls, and mortars for pounding Indian corn.

They made coarse pottery of clay. De Soto found the Indians of the Mississippi using pounded mussel shells in their pottery, which was equal to that of Portugal. It was unglazed.

Gold and silver they pounded or bent into rude ornaments.

Copper was generally used for ornaments, but some tribes, as in Mexico, knew how to smelt it; and it was formed into axes and cutting tools.

Meteoric iron converted into knives was found among the Esquimaux by Ross and Parry.

Columbus states that at Honduras a trading canoe brought him "small hatchets made of copper to hew wood, small bells and plates, crucibles to melt copper, etc.

Del Rio speaks of vessels of silver from the province of Chiapa, among which was a silver chalice, that was afterward used in the service of the altar.

Juarros mentions star-shaped ornaments worn by the Quiche nobility, and Herrera says the goldsmiths of Nicaragua "wrought and cast gold extraordinary curiously."

Dogs were used for drawing burdens. De Soto found them in

Florida and Louisiana (1540). The Esquimaux yoked reindeer or dogs to their sledges, and also used them for hunting and for food.

The Quiches had places for breeding geese, that were kept for furnishing feathers. Turkeys and various animals were domesticated.

Coronado, in his expedition to Cibola (1540), describes the Indians of New Mexico as using dogs for draft.

They told fictitious tales, chanted their exploits in hunting and in war, recited poetry, and sang songs to the sound of drums and rattles.

They practiced wrestling, leaping, foot races and shooting with the bow.

Their most notable game was ball, played by two parties or two tribes. The contest was to force the ball against one of two wickets, placed five hundred yards apart. The players were dressed in their most elaborate costume, and each carried a species of racket with which to strike or catch the ball. Who first carried the ball twelve times through their wicket, won. It was fair to strike, trip, grapple, or take any advantage of strength or cunning.

Parties in the game were arranged according to their family colors,[1] as among the Sauks, the reds, blues, blacks and whites were paired off, all of similar colors together.

Chungke was played by many tribes in North America (see Adair, Bartram, Catlin). They used a discoidal stone three to six inches in diameter. Each party had a pole about six feet long, with little thongs of leather tied on it at intervals of one foot. The stone was rolled along the ground, the stick thrown after it, and whoever threw nearest the stone, or so that the thongs of leather fell through the hole in the center of the stone, won the game.

These stones were made with great labor—some of compact quartz, well polished; they were kept from generation to generation, and belonged to the town. The Mexicans were devoted to this game.

The game of dish or platter consisted of throwing up pieces of flat bone, or plum stones; they fell in a dish or on a mat. According to the number of colored sides uppermost, the thrower lost or won.

A game played with two hundred and one, or fifty-two straws, was played by the Algonquins.

Indians gambled to great excess, and staked furniture, clothes, tools, personal liberty, or even their scalp-lock.

Dancing was one of their daily amusements, and they have them of every possible variety, commemorative of all the events of Indian life—war, hunting, planting corn, worship of sun, etc. The war dance is performed about a painted pole, and those who enlisted for the enterprise struck the pole with their tomahawks or war clubs. The women had dances among themselves, accompanied with musical instruments and the singing of rhythmic sounds. Their instruments consisted of rattles, bunches of deer hoofs, notched sticks, drums, tamborines, flutes and whistles.

Tobacco is indigenous to America. It was used most in climates where it grew. The Indians of North America used pipes—bowls curiously carved out of stone, or of "catlinite." The Mexicans used reeds and tubes filled with tobacco, or with other weeds, and bark or leaves of trees, as willow, sumach, etc.

Some chew the inner bark of the pine tree, which furnishes a resin like tolu.

The Creeks and Choctaws prepared a drink from the cassine (Prinos glober) called black-drink; it was emetic.

Col. S. H. Long says that the Otoes prepared a drink from the seed of the "intoxicating" bean."

The Mexicans prepared the pulque, but none but grandfathers and grandmothers were permitted to use it under pain of death.

Lime of burnt shells was used with certain plants for chewing, by the American, as well as the Asiatic, Indians.

Intoxicating drinks can be readily made out of honey and water. Clavigero states that there are six different kinds of bees in Mexico.

All nations know that grain bruised or mashed will make intoxicating drinks, and all rude nations seem to find their supremest delight in excessive quantities of intoxicating drinks.

Juarros remarks that the Quiches were intemperate in their habits, and that they made ten different kinds of drinks from maize. In Yucatan, the natives intoxicated themselves with a liquor made of honey and water. In Honduras they used certain roots and fruits steeped in water and then submitted to fermentation.

Sweating baths or steam baths are among the luxuries of our Indians. A hut of skin or bark is constructed with a scaffold or platform of trellis work, a foot or so above the ground; here the

Indian takes his place. Hot stones have been placed beneath the platform and upon them water is thrown. The water is converted into steam, and the Indian, carefully closed up in the hut, can enjoy a profuse perspiration. This bath is often used to cure sickness as well as for gratification.

Among some tribes the highest value is placed upon virtue, but generally the women are free to act as they please, until the authority of the husband is asserted.

Polygamy prevails everywhere. The number of wives is limited only by the means of the man. They all recognize certain degrees of relationship within which marriage is unallowable. The husband fishes, hunts and fights. The wife makes the hut, the implements of housewifery, attends to domestic affairs, and cultivates the ground. The lower class of European women are not treated any better than the Indian squaws.

The women gather in the fuel and the food. They generally outlive the men.

Religion instructs man in his duty to God and his duty to his neighbor. It teaches the distinction between right and wrong, and enforces the laws of correct moral conduct. The moral duties are feebly performed, if not grossly violated, by those who acknowledge not the force of religion. Every tribe in our land have some sort of belief. The Sioux worship numerous spirits, who, they think, preside over lakes, rivers and mountains.

The Six Nations worshiped the Great Spirit and numerous other gods, and an infinite number of Genii, or Wakondas.

The tribes of Virginia believed there were tutelary deities who presided over every town.

McKenzie gives an account of an Indian who told him that a disease he was ailing from was sent as a punishment for an act of unnecessary cruelty in burying alive a she wolf and her whelps.

The Aztecs believed in a future state, and in a system of rewards and punishments corresponding to the acts done in this life.

All had certain sacrifices, devotions and ceremonies used for divine worship.

The Pawnees offered up human sacrifices, cutting up the flesh of the victim as an offering to the planet Venus, the Great Star, and squeezing the blood on the tops of the hills of corn in order to obtain abundant crops.

Petalasharon once performed a daring deed by rescuing an

Ietan maiden from the stake, in a Pawnee village, and again he rescued a Spanish boy.

The functions of priest, physician, and conjurer or magician is exercised by the great medicine man, or often by the chief. It is his province to control the weather, bring good luck in hunting and fishing, and in war, also cure diseases, or effect all that is possible to supernatural powers.

Almost everything of remarkable appearance, or of great rarity, is regarded with superstitious reverence—they paid the greatest homage to the devil. He was the god to be feared and conciliated, as he alone was the god who might do them evil. The Virginians made an idol of the devil, which they painted and adorned with copper chains and beads, and covered with skins.

The Creeks worshiped a statue of wood. Similar figures were seen among the southern Indians by DeSoto. Columbus found stone idols (cemies) among the Haitiens.

The paintings and sculptures on rocks have been attributed to the medicine men—as those on the Mississippi, among the Ricarees, Dighton Rock in Massachusetts, in New Mexico, Kelly's Island, Lake Erie, and other places.

The Narragansetts had a temple in which fire was kindled. The building was spacious.

The Virginians had temples, which were large cabins decorated with significant carvings and paintings, intended for the purpose of maintaining their perpetual fire.

The Indians of Natchez, Mexico, Louisiana, Florida and the northwest coast erected temples of superior construction and of architectural qualities. At a temple in California, the idol is described by Venegas as holding in her right hand the figures of the sun and moon. Two large crows were about the enclosure, which the Spaniards killed, and this threw the Indians into great alarm.

Certain places were regarded as sacred: as among the Sioux, Pipe Creek, which flows through cliffs of catlinite, where tribes at war met without hostility at the quarries. Also the medicinal springs at the head of the Washuta, and the springs in Colorado, at the head of the Arkansas, where the trees were hung with native offerings.

Nearly every tribe once possessed its idols, but they have been destroyed in the religious crusades of the whites.

Human sacrifices of the prisoners taken in war were offered up in the temples of the Aztecs. It is stated by Clavigero, that the Tlascan general Tlahuical, captured by the Ottomies, was presented to Montezuma, who offered him the post of commander of the Mexican armies. He refused to become a traitor to his country, and said he preferred to die a gladiatorial sacrifice upon the "Temelacotl," or round stone. Several bold men attacked him, of whom he is reported to have killed eight and wounded many others: when, fainting from a severe wound in the head, he was carried before the idol Huitzilopotchli, where the priests tore out his heart, and threw his body down the steps of the temple.

Of the religious structures erected by the semi-civilized Indians, the pyramidal temple of Cholula is the largest. It was dedicated to Quetzalcoatl, god of the air. It has four stories of equal height. It is oriented. Its perpendicular height is one hundred and seventy-seven feet, and each side of the base is fourteen hundred and twenty-three feet. It is, then, twice as broad as the Great Pyramid. Its height is a third more than the pyramid of Mycerinus.

The two pyramids of Teo-tihuacan, which are twenty-four miles northeast of the City of Mexico, were originally of four stories. The one erected to the sun is now one hundred and eighty feet high and six hundred and eighty-two feet broad at the base. The pyramid of the moon is much smaller than that of the sun.

The numerous small temples of the Mexicans were composed of a small single mound with steps leading directly to the top.

It is generally admitted that the Egyptians, Chaldeans, Hindoos, Phœnicians and others possessed a mythology based upon a system once common to all ancient nations, and from the dissimilarity of their analogies, we can assert that it is a great length of time since they have been separated. Among the traditions of the Mexicans, I will speak of one narrated by Humboldt.

The people of Mechoacan had a tradition in relation to their Noah, whom they call Coxcox or Tezpi, who embarked in a spacious vessel with his wife, children, various animals and vegetables, whose use was important to man. After the water began to assuage, Tezpi sent out of the ark a vulture, to ascertain the state of the waters, but this bird, enticed by the carrion so plentifully strewed about, did not return. Tezpi sent out other birds; only the humming-bird returned, holding in its beak a branch covered with leaves. * * Tezpi, knowing the earth had begun to produce vegetation, left his vessel on the mountain of Colhuacan.

In a Mexican picture there appears the serpent talking to the goddess Cihuacohuatl: near by are two naked figures of different color, who seem to be contending. The "serpent woman" was considered in Mexico as the mother of twins, and these naked figures remind us of Cain and Abel, of Hebrew tradition. (See Humboldt.)

* * Burials are accompanied by manifestations of grief, which all mankind must naturally feel on the loss of endeared friends and relatives. Eulogiums are sometimes pronounced on the deceased, faces are blackened, hair is cut off, flesh is lacerated, and personal decorations laid aside by the mourners. Corpses are buried in a sitting position. Coffins are not used. Mounds are often erected over the body. Some tribes burn the dead, others place the bodies on scaffolds. On the Pacific Coast the bodies are placed in canoes with their blankets and household goods, and raised up on scaffolds, where the wolves will not get at them. After a time the bones are placed in a common grave. Some dig pits thirty feet wide; the bottom is paved with stones.

In Virginia and Maryland they dried the bodies of chiefs and kings,—then they were preserved in their temples.

They buried with the corpse, dogs, bows and arrows, food and water, etc., for they believed that the future life was like the present—excepting for the mitigation of its ills and inconveniences—that each one would indulge the inclinations and follow the occupations which he had loved in this world, therefore would need those things which are serviceable or agreeable to him in this life.

The Natchez Indians burned their dead on scaffolds. When their "suns" or kings died, many of his subjects were put to death, especially the wife or wives of the deceased, who always belonged to the plebian or paria caste.

The custom of putting persons to death at the funerals of the great was common in the time of DeSoto. The historians of Louisiana state that the people yielded themselves to those sacrifices with singing and dancing, and women with children at the breast gave up their lives as if it were a great privilege.

Their calendar was of the simplest kind. They divided the year into moons. Humboldt says the people of Nootka Sound have months of twenty days, fourteen of which constituted a cycle. The Mexicans had the same length of month, and eighteen months in a year.

Indians count their time by nights. They take special note of the North Star, of the circumpolar stars, and of conspicuous constellations, to which they give names and attribute certain superstitious influences.

They all note the motions of the shadow of a plumb line, as the sun traverses his course from rising to setting.

They note north and south points on the meridian, the east and west points on the prime vertical, as well as the sun's change in azimuth—as it passes between the extreme limits of its rising and setting on the 21st of March and the 21st of December. This enables them to determine the length of the solar year, and those nations that had fixed abodes and lived in houses, like the Mexicans, attained a most wonderful knowledge of astronomy (see de Gama).

In arithmetic they used the decimal system, counting on their fingers. Their games and tradings made them familiar with numbers, as in the game of straws, which was played with two hundred and one, or with fifty-two twigs or straws.

The Aztecs of the City of Mexico kept the neighboring nations in subjection, and compelled them to pay tribute to Montezuma. Among the articles supplied were four million nine hundred thousand three hundred fanigas of maize. Dots were used to designate the first nineteen numbers. Twenty is designated by a flag; four hundred by a feather; and eight thousand by a mirror. It must have required much arithmetical skill to keep the necessary accounts connected with this business of collecting tribute, and in the calculations of solar and lunar calendars.

All social compacts required the surrender of individual or party rights to the good of the whole nation.

The nationality was determined by blood; they were divided into gintes, fratres and tribes.

A tribe was an association of kindred, a nation an association of tribes. Certain badges or tokens distinguished different families and different nations.

The government in theory was monarchical, in war it was despotic, in general practice it was democratic. Public affairs were decided upon in council.

We find that the tribal organizations of all aborigines are divided into *gens*, *fratres* and *tribes*.

1st, The GENS are bound together by ties of blood, having a common gentile name.

2d, The FRATRY are an assemblage of related gentes, united for certain common objects.

3d, The TRIBE, an assemblage of fratres, all of whom speak the same dialect.

Intermarriage of the gens is prohibited. These subdivisions are best displayed in the organization of the Mohegan tribes. It had three original "gentes," as the WOLF, the TURTLE and the TURKEY. They are as follows:

1. WOLF FRATRY.

Gentes. 1 Wolf; 2 Bear; 3 Dog; 4 Opossum.

2. TURTLE FRATRY.

Gentes. 5 Little Turtle; 6 Mud Turtle; 7 Great Turtle; 8 Yellow Eel.

3. TURKEY FRATRY.

Gentes. 9 Turkey; 10 Crane; 11 Prairie Chicken.

All our Indians have their special designation painted on their buffalo robes, or wear it as a talisman about their necks. The Quiches wore a white mantle over their shoulders, upon which were depicted the pictures of birds, ocelots, wolves, dogs, deer, serpents, apes, birds, etc.

Laws they had none, but their customs were founded upon justice and equity. Disputes were arbitrated by friends, and by public opinion. Thieves were required to make restitution. Murder was punished by death inflicted on the criminal or on his nearest of kin by the kindred of the deceased. Sometimes gifts or captives taken in war were accepted as a compromise.

Witchcraft was generally punished as a private wrong. Sometimes by the decree of council.

Among some tribes, women and even infants governed in virtue of hereditary right. Hereditary right was recognized among the Sioux, the Wyandots, Osages, Pawnees and other tribes. Kingly ceremonies were observed, and Columbus describes a chief of Hayti, who came to see him, carried on a palanquin by his subjects, and who treated him with the greatest respect.

Powhatan, the father of Pocahontas, exercised absolute sway over his subordinate chiefs. Smith says he was obeyed, "not only as a king, but as a demigod they esteem him; what he commandeth they dare not disobey in the least thing." * * In Mexico there

was a distinction of castes marked by colors of costume. Royalty wore purple, the nobility scarlet, the commons yellow.

War is the only high road to distinction, but oratory, hunting and skill in athletic sports are highly prized. Indians are constantly engaged in war, their object being, for revenge, for the support of rights to hunt or fish, to possess the lands of another tribe, to obtain prisoners for slaves or sacrifices, or for the love of military glory.

They generally do not notify their enemy, and seldom take the field in numerous bodies. For want of provision or food, and other conveniences, in quantity, can not keep large armies together for a long period.

Their warriors are often obliged to go through most cruel and bloody ceremonies before the youths are admitted to the rank of warriors. (See Catlin among the Mandans).

Their weapons consist of bows and arrows, lances, spears, war clubs, slings, tomahawks, lassoes. The Choctaws used blow-guns, from which they shot an arrow feathered with the down of the thistle. In Mexico they were called "*cerbotlane*," and Montezuma compared the muskets of the Spaniards to this weapon.

Lewis and Clark, and Carver describe a species of tomahawk called "pogamoggion," used by tribes of the West, the Shoshones and the Chippeways.

The Toltecs used a species of sword; it consisted of a long club set with two opposite rows of sharp flints.

The Algonquins and Iroquois used a kind of cuirass made of rushes, or pliable sticks.

The Virginians used armor made of sticks wickered together with thread.

The Shoshones covered the body with skins, united together with glue and sand; and many tribes used round shields made of thick bull hide.

For purposes of defence and to give protection to an inferior force, they fixed strong pickets around their villages, or raised an earthen bank, on the tops of which they planted palisadoes. Hochelaga near Montreal was fortified with three lines of wooden ramparts; on the inside were stages accessible by ladders, on which heaps of stones were collected, to cast down on the heads of the foe. Many towns in Canada were palisaded.

Champlain describes forts on the St. Lawrence.

The Sioux of the plains can quickly cover themselves from their foes, by digging holes and throwing up breastworks.

SCALPING.

This custom was practiced by the Chicenecas, or barbarous tribes of Northern Mexico. They were borne off as trophies of prowess. This practice is not observed by the Indians west of the Rocky Mountains, but the natives of Nootka carry off the skulls of their enemies. The custom prevailed in eastern Asia. Herodotus ascribes it to the Scythians, who suspended the scalps from the bridles of their horses.

The wild Indians generally mutilate the dead bodies. They cut off the head, ears, nose, lips, hands or feet, and the tendons in the bend of the arms, and opposite the knee-cap, or slit open the chest and tear out the heart and viscera.

The captive foe is tortured at the stake. The tribe looks on with a spirit of revenge and exultation, while the victim taunts his tormentors with their inability to inflict pain.

Captives are sometimes distributed among the tribe, and Bartram describes a Creek chief who was attended by Indian slaves captured in war. The friends of captives regard them as dead.

TREATIES.

All treaties are attended with the ceremony of smoking the calumet or pipe of peace—and in the exchange of belts of beads called wampum. The great men made speeches, which are heard in profound silence and with strict attention.

The calumet is regarded as sacred, it is never suffered to touch the ground, and the chief who presents it narrates the history of the important ceremonies when it was used. The stem is generally flat, of wood, four feet long, decorated with beads, and porcupine quills of brightest colors, and a fan-shaped ornament of eagle's feathers; the bowl is of red catlinite. This pipe confers inviolability on those who carry it.

The Indians as far west as the Rocky Mountains use it. The Canada Indians say it originated with the Pawnees of Missouri. This statement is confirmed by the Mandans and Minstarees. (See DuPratz, History of Louisiana). DeSoto, Hudson, Herriot, and Smith, do not say much about the calumet.

The belts of wampum were intended to remind the parties of the various articles in the treaty. The belt has no special hieroglyph-

ics, but it is worked with peculiar marks which serve as mementoes. The beads are white, and blue, and are formed out of clam-shells. These belts were used like the quippos or knotted cords of the Mexicans and Peruvians—they record facts and note dates and accounts.

The knowledge of the Indian of natural history is indeed great. By closest observation he has rendered himself familiar with all kinds of plants, insects, fish, birds and animals. He knows their names, and peculiar properties, and the uses of the various objects in creation—and he delights to talk about the peculiar characteristics of animals, of their habitations, their food, and the best methods of capturing them, and he naturally condemns the wasteful slaughter of the beasts of the field; and during certain seasons of the year observes the practice of leaving them in peace to breed and raise up the young, so that their increase shall be maintained.

Before going on a bear hunt, they give several days in succession to the celebration of the "bear dance," in which they all join in a song to the Bear Spirit, which they think holds somewhere an invisible existence, and must be consulted and conciliated, before they can enter upon the excursion with any prospect of success, unless they should conform with the strictest adherence to all the details of this indispensable and sacred ceremony.

CHARACTER.

Their character must not be judged by the Indians of the present time, who have had all their nobler sentiments destroyed during a period of four hundred years of cruelty, oppression and injustice. The Indian of the present day is treacherous, ferocious and savage, filthy, miserable, drunken, broken-hearted and beggarly.

Catlin says: "By nature they are decent and modest, unassuming and inoffensive, and all history proves them to have been found friendly and hospitable, and this has always been their conduct on the first approach of the white people to their villages, on all parts of the American continent.

In Washington Irving's account of the wanderings of Bonneville among the "Nez-perces" and "Flat-heads," he says: "They were friendly in their dispositions, and honest to the most scrupulous degree in their intercourse with the white men." * * To simply call these people religious would convey but a faint idea of the deep hue of piety and devotion which pervades the whole of their conduct. Their honesty is immaculate; and their purity of

purpose, and their observance of rites of religion, are most uniform and remarkable. They certainly are more like a nation of saints than a horde of savages."

The great Columbus wrote back to the royal Ferdinand and Isabella, as follows: "I swear to your Majesties that there is not a better people in the world than these; more affectionate, more affable and mild. They love their neighbors as themselves, and always speak smilingly."

Wm. Penn, the Quaker, who came over in 1682, treated the Indians with honesty and justice. He said he believed that Indians had souls. He appointed juries to try Indian offenders, to consist of six white men and six Indians. He had no troops and no forts. Penn made a treaty with the Indians at Kensington, now within the limits of Philadelphia. This treaty "was never sworn to, and never broken"—a monument marks the spot. He lived with the Indians in peace for sixty years, and not a drop of Quaker blood was ever shed by the Indians.

The Swedes and Fins settled in Delaware in 1631, and they had no trouble with the Indians. There was no trouble in New Jersey.

The French came, and in 1673 Marquette and Jolliet and Hennepin explored the Mississippi.

The brave cavalier LaSalle (1631) with twenty-three Frenchmen and thirty-one Indians, sailed down the Illinois and on to the mouth of the Mississippi. He was welcomed and feasted by the Indians of the Arkansas, whom he describes as "a lively, civil, generous people," with a tendency toward civilization, having domestic fowls wandering among their rude cabins of bark. He at last arrives in sight of the great Gulf of Mexico, and takes possession of Louisiana in the name of Louis XIV. * * The Indians do not molest these expeditions, and submit peacefully to be despoiled of their possessions.

We can all recall the generous act of Pocahontas, a girl of thirteen summers, in throwing herself at the feet of her father, Powhatan, and saving the life of John Smith, who lay on the ground bound hand and foot and ready to be executed with the war club.

Shortly after the conquest of Mexico, Vasco Nunez invades the regions near Darm aud captures the chief, who reproaches him with ingratitude, and yet gives him his daughter, saying:

"Behold my daughter. I give her to thee as a pledge of my

friendship. Take her for thy wife, and be assured of the fidelity of her family and her people."

Their hospitality is boundless—the kettle is ever hanging on the fire. No stranger visits an Indian dwelling but they set food before him, and always the best they have.

When Sir Walter Raleigh's fleet visited Albermarle Sound in the summer of 1584, they met with the chief Grangavimeo, of whom they said: "He was very just of his promises; for oft we trusted him, and he would come within his day to keep his word. He sent us commonly, every day, ducks, conies, hares, and fish, sometimes melons, walnuts, cucumbers, peas, and divers roots." * * "Their drink is commonly water, boiled with ginger, and sometimes with sassafras." * * "A more kind and loving people can not be."

When DeSoto visited Florida in 1539, near Ocute, "The cacique sent him two thousand Indians with a present, to-wit: many conies and partridges, bread of maize, hens, and many dogs. Two leagues before he came to Chiaha, there met him fifteen Indians loaded with maize which the cacique had sent, and they told him on his behalf that he waited his coming with twenty barns full of it.

After crossing the Mississippi he rested in *Pacaha* forty days, in all which time the two caciques served him with great store of fish, mantles and skins, and strove who should do him the greatest service.

We have now given a few of the thoughts in regard to the origin, language and character of the Red Men.

Changed as they have become from their original nobleness of character, we still find many individual instances of their high sense of truth and honor.

Judging from the past, it will not be many years before they will become extinct.

Such characters as they have displayed ought not be suffered to pass away into entire oblivion—and we should do all we can to obtain portraits and biographies of some of the noble and great individuals of the race of Red men, such as—

Pontiac,	Cochise,	Billy Bowlegs,
Tecumseh,	Petelasharo,	Ross,
Powhatan,	Ridge,	Logan,
Pocahontas,	Ross,	Sitting Bull,

Brant,	Sequoya,	Tamanend (Del.),
Red Jacket,	Opathele Tahola,	David Cusick,
Corn Planter,	Black Hawk,	Canon-chet,
Uncas,	Keokuk,	Mica-nopii,
King Philip,	Osceola,	Little Hill (Winnebago).
Hiawatha (of the Six Nations),		

I think there can be no doubt in the mind of any one who has studied the history of the North American Indians, that the civilization of the Aztecs would have extended itself over our continent. When we consider their high culture, their progressive policy and their great valor—they had already compelled the neighboring nations to pay them tribute, and were extending their dominion wherever they could find organized nations to conquer. It wanted only that the cruel invasion and policy of extermination of the Spaniards could have been delayed another century.

The Anglo-Saxons and the Gauls, when conquered by Cæsar, were in an inferior state of civilization to the races that peopled the regions of Anahuac, and they, when relieved from the cruel oppression of the Romans, developed into the grandest nations of the eastern hemisphere, the kingdom of Great Britain and the Empire of Germany. But in this hemisphere, cruelty, tyranny and oppression entirely destroyed the development of the Red Men.

NOTES ON OHIO BIRDS.

By Charles Dury.

In the spring of 1860, my father moved to Avondale, building a house on a five-acre meadow. Across one end of the place was a deep ravine, through which ran a brook. The place had on it but one tree and a few willow bushes. On my first visit to it I saw but one bird, a "Meadow Lark" (*Sturnella magna*). During 1860, '61 and '62 we planted the place thickly with trees and shrubbery of many kinds. We also made an embankment across one end of the ravine, retaining the water in a large pond. The trees made rapid growth, and in twenty years the place was like a forest, some of the poplars measuring twenty-two inches in diameter of trunk. As the environment changed and became more favorable, birds came in great numbers, until I have recorded the occurrence of one hundred and thirty-two species. We greatly enjoyed the presence of these birds, and gave them protection. Our martin-box attracted a swarm of martins, who nested in it every year. Boxes and tin cans placed in suitable places attracted wrens, bluebirds, and an occasional Great Crested Fly-catcher. The Carolina titmouse made its nest in a deserted wood-pecker's hole in an old fence-rail, and a pair of these birds, as though loth to leave the old place, this year built a nest and reared their brood in a hole in a hollow iron hitching-post which is planted within a few inches of the public sidewalk, along which many people pass every day, and so skillfully did she manage her entrance and exit that no meddling boy discovered her nest. An old dead limb of an elm tree served as a nesting place for a pair of "red-headed wood-peckers," who made a round hole in it and reared their brood. The next year a pair of "flickers" enlarged the cavity and used it for the same purpose, after which screech owls used it for a secure retreat, I having enlarged the opening so I could introduce my hand. Out of this hole I secured many fine specimens of owls. When the European sparrow came, it appropriated the hole. This caused me to break off the limb. Our large evergreens afforded a retreat for many species, the bronzed grakles placing their nests in every tuft and crotch suitable for the purpose in

the pines, and their loud, scolding notes warned us of the approach of an intruder; even the timid crow came into the trees in comparative security. For years I have lived with these birds. Year after year they came back, reaching their old haunts a few days earlier or later each year, as the season was early or late. The old pond is now filled up and houses are built on its site, many of the trees and bushes are gone and the birds have sought more congenial places, until hardly a "corporal's guard" of their former great numbers remain. And instead of the beautiful song of the "brown thrasher" and the cheerful notes of the "song sparrow," we have the unmusical chatter of the pestiferous European sparrow. Since the introduction and multiplication of this bird, the house wrens and song sparrows have completely disappeared. Below I give a list of the species:

Podilymbus podiceps (L.) Pied billed Grebe.
Anas carolinensis Gm. Green winged Teal.
Anas discors Linn. Blue winged Teal.
Charitonetta albeola (Linn.) "Butter ball Duck."
Botaurus lentiginosus (Mon.) Bittern.
Ardea virescens Linn. Green Heron.
Porzana carolina (Linn.) Sora Rail.
Philohela minor (Gm.) Woodcock.
Gallinago delicata (Ord.) Wilson's Snipe.
Totanus solitarius (Wils.) Solitary Sandpiper.
Actitis macularis (Linn.) Spotted Sandpiper.
Aegialitis vocifera (Linn.) Killdeer.
Colinus virginianus (Linn.) Bob-white.
Ectopistes migratorius (Linn.) Wild Pigeon.
Zenaidura macroura (Linn.) Mourning Dove.
Accipiter velox (Wils.) Sharp-shinned Hawk.
Accipiter cooperi (Bon.) Cooper's Hawk.
Buteo lineatus (Gmel.) Red-shouldered Hawk.
Buteo latissimus (Wils.) Broad-winged Hawk.
Falco sparverius Linn. Sparrow Hawk.
Asio wilsonianus (Less.) Long-eared Owl.
Asio accipitrinus (Pall.) Short-eared Owl.
Syrnium nebulosum Gray. Barred Owl.
Megascops asio (Linn.) Screech Owl.
Bubo virginianus (Gm.) Horned Owl.
Coccyzus americanus (Linn.) Yellow-billed Cuckoo.

Coccyzus erythropthalmus (Wils.) Black-billed Cuckoo.
Ceryle alcyon (Linn.) Belted Kingfisher.
Dryobates villosus (Linn.) Hairy Woodpecker.
Dryobates pubescens (Linn.) Downy Woodpecker.
Sphyrapicus varius (Linn.) Yellow-bellied Woodpecker.
Melanerpes erythrocephalus (L.) Red-headed Woodpecker.
Melanerpes carolinus (L.) Red-bellied Woodpecker.
Colaptes auratus (Linn.) Flicker.
Antrostomus vociferus (Wils.) Whip-poor-will.
Chordeiles virginianus (Gmel.) Night Hawk.
Chætura pelagica (Linn.) Chimney Swift.
Trochilus colubris Linn. Ruby-throated Hummingbird.
Tyrannus tyrannus (Linn.) Kingbird.
Myiarchus crinitus (Linn.) Crested Flycatcher.
Sayornis fuscus Bd. Phœbe.
Contopus virens Cab. Woodpewee.
Empidonax flaviventris Bd. Yellow-bellied Flycatcher.
Empidonax acadicus Bd. Acadian Flycatcher.
Empidonax minimus Bd. Least Flycatcher.
Otocoris alpestris (Linn.) Horned Lark.
Cyanocitta cristata (Linn.) Blue Jay.
Corvus americanus Aud. American Crow.
Molothrus ater (Bodd.) Cowbird.
Agelaius phœniceus (Linn.) Swamp Blackbird.
Sternella magna Sw. Meadow Lark.
Icterus spurius (Linn) Orchard Oriole.
Icterus galbula (Linn.) Baltimore Oriole.
Scolecophagus carolinus (Mull.) Rusty Blackbird.
Quiscalus quiscala æneus (Ridgw.) Bronzed Grakle.
Carpodacus purpureus (Gmel.) Purple Finch.
Loxia curvirostra minor (Brehm.) American Crossbill.
Loxia leucoptera (Gmel.) White-winged Crossbill.
Spinus tristus (Linn.) American Goldfinch.
Spinus pinus (Wils.) Pine Siskin.
Poocætes gramineus (Gmel.) Vesper Sparrow.
Chondestes grammacus Bon. Lark Finch.
Zonotrichia leucophrys (Forst.) White-crowned Sparrow.
Zonotrichia albicollis (Gm.) White-throated Sparrow.
Spizella monticola (Gmel.) Tree Sparrow.
Spizella pusilla (Wils.) Field Sparrow.

Spizella socialis (Wils.) Chipping Sparrow.
Junco hyemalis (Linn.) Snowbird.
Pyrgita domestica Cuv. European Sparrow.
Melospiza fasciata (Gm.) Song Sparrow.
Passerella iliaca (Merr.) Fox Sparrow.
Pipilo erythrophthalmus (Linn.) Towhee.
Cardinalis cardinalis (Linn.) Cardinal Grosbeak.
Habia ludoviciana (Linn.) Rose-breasted Grosbeak.
Passerina cyanea (Linn.) Indigo-bird.
Spiza americana (Gm.) "Dickcissel."
Piranga erythromelas (Viell.) Scarlet Tanager.
Piranga rubra Linn. Summer Tanager.
Progne subis (Linn.) Purple Martin.
Petrochelidon lunifrous (Say.) Cliff Swallow.
Chelidon erythrogaster (Bodd.) Barn Swallow.
Clivicola riparia (Linn.) Bank Swallow.
Stelgidopteryx serripennis (Aud.) Rough-winged Swallow.
Ampelis cedrorum (Viell.) Cedar-bird.
Lanius borealis (Viell.) Northern Shrike.
Vireo olivaceus (Linn.) Red-eyed Vireo.
Vireo gilvus (Viell.) Warbling Vireo.
Vireo flavifrons Viell. Yellow-throated Vireo.
Vireo noveboracensis (Gm.) White-eyed Vireo.
Mniotilta varia (Linn.) Black-and-white Warbler.
Helmitherus vermivorus (Gm.) Worm-eating Warbler.
Helminthophila pinus (Linn.) Blue-winged Warbler.
Helminthophila ruficapilla (Wils.) Nashville Warbler.
Helminthophila peregrina (Wils.) Tennessee Warbler.
Compsothlypis americana (Linn.) Parula Warbler.
Dendrœca æstiva (Gm.) Yellow Warbler.
Dendrœca cærulescens (Gm.) Black-throated Blue Warbler.
Dendrœca coronata (Linn.) Myrtle Warbler.
Dendrœca maculosa (Gm.) Magnolia Warbler.
Dendrœca pennsylvanica (Linn.) Chestnut-sided Warbler.
Dendrœca blackburniæ (Gm.) Blackburnian Warbler.
Dendrœca dominica albilora Bd. Sycamore Warbler.
Dendrœca virens (Gm.) Black-throated Green Warbler.
Dendrœca vigorsii (Aud.) Pine Warbler.
Dendrœca palmarum (Gm.) Palm Warbler.
Seiurus aurocapillus (Linn.) Oven-bird.

Seiurus noveboracensis (Gm.) Water Thrush.
Geothlypis agilis (Wils.) Connecticut Warbler.
Geothlypis philadelphia (Wils.) Mourning Warbler.
Geothlypis trichas (Linn.) Maryland Yellow-throat.
Icteria virens (Linn.) Yellow-breasted Chat.
Sylvania canadensis (Linn.) Canadian Warbler.
Setophaga ruticilla(Linn.) American Redstart.
Mimus polyglotta (Linn.) Mockingbird.
Galeoscoptes carolinensis (Linn.) Catbird.
Harporhynchus rufus (Linn.) Brown Thrasher.
Thryothorus ludovicianus (Lath.) Carolina Wren.
Thryothorus bewickii (Aud.) Bewick's Wren.
Troglodytes ædon Viell. House Wren.
Troglodytes hiemalis Viell. Winter Wren.
Certhia familiaris americana (Bonap.) Brown Creeper.
Sitta carolinensis (Lath.) White-breasted Nuthatch.
Parus bicolor (Linn.) Tufted Titmouse.
Parus carolinensis Aud. Carolina Chicadee.
Regulus satrapa Licht. Golden-crowned Kinglet.
Regulus calendula (Linn.) Ruby-crowned Kinglet.
Polioptila cærulea (Linn) Blue-gray Gnatcatcher.
Turdus mustelinus Gm. Wood Thrush.
Turdus ustulatus swainsonii (Cab.) Olive-backed Thrush.
Turdus fuscescens Steph. Wilson's Thrush.
Merula migratoria (Linn.) Robin.
Sialia sialis (Linn.) Bluebird.

In addition, the Bald Eagle, Red-tailed Hawk, Turkey Vulture, Great-Blue Heron, Canada Goose and many species of Ducks have been observed flying over. Of this list, forty-two species have been known to nest.

OCCURRENCE OF "LITTLE BLACK RAIL," (*Porzana jamaicensis* CASS) IN OHIO.

(Read June 2, 1890.)

THE specimen of this diminutive and interesting rail which I exhibit was taken at Ross Lake, near Carthage, May 17, 1890. It is an adult male; two were seen, but the other escaped. This is the first recorded instance of its capture in Ohio that I am aware of. In a list of birds of the vicinity of Cincinnati published by Dr. Langdon in 1877, he includes this species, but in a later list

published by this Society, January, 1879, he excludes it for want of positive identification. In the most complete and valuable list and notes on Ohio birds, in the fourth volume of Ohio Geological Survey, by our late talented friend, Dr. Wheaton, he says: "Mr. Langdon introduces this bird to our acquaintance in his catalogue of the birds of the vicinity of Cincinnati, in which he says, 'A rail shot by myself near Madisonville several years ago I now think was this species.' In addition to this, Dr. Howard E. Jones is almost positive he has killed it in the vicinity of Circleville, O. It is also reported from Northern Ohio, but of this I have not as yet obtained positive evidence. As Dr. Langdon omits it from his later list, we must wait more positive identification than the above."

Twenty-five years ago, when Millcreek was a pure and beautiful stream, and when water birds came to it during their migrations in great flocks, while searching for rare birds along one of the tributary creeks, I saw one of these birds running ahead of me along the bank. As I came near, it plunged its head and neck into a tuft of dry grass, perhaps imagining itself to be hid. I picked it up and took it to an old taxidermist, who did not know what it was, and I never saw it again. I had always suspected it to be this species, and when I got the specimen exhibited, I was positive the other was the same. It is perhaps more numerous than has been supposed, but owing to its habit of hiding in swampy places has escaped observation.

OCCURRENCE OF THE LEAST BITTERN. *Botaurus exilis* (GMEL.) NEAR CINCINNATI.

Since the artificial lake near Carthage (known as Ross Lake) has been made, many aquatic birds resort to it during their migrations, that have rarely or never been seen in this locality. An instance of this is the "Least Bittern." During last May a dozen might have been seen any day by wading through the swampy border of the lake. Some beautiful specimens were secured.

I am indebted to Master Ralph Kellogg, one of our most energetic young collectors, for specimens of Least Bitterns and the Little Black Rail.

THE JOURNAL

OF THE

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PROCEEDINGS.

Regular Meeting, *July* 1, 1890.

No meeting. Very hot weather.

Regular Meeting, *August* 5, 1890.

No meeting. Excessively warm.

Regular Meeting, *September* 2, 1890.

Vice-President Harper in the chair.

There were thirty members present.

The minutes of the June meeting were read and approved.

Latham Anderson, Dr. J. L. Krouse and Enoch Megrue were proposed for active membership.

S. E. Wright was elected an honorary member.

The minutes of the Executive Board for May and June were read.

The Secretary reported that in the matter of the reported exhumation of pre-historic relics at Lawrenceburg, Indiana, he found, upon investigation, that it was not of sufficient importance to warrant further consideration.

The resignations of Miss Eliza A. Fisher, J. Kyle Holloway, Raymond Cilley and Dr. J. H. Buckner were accepted.

Prof. Geo. W. Harper gave an informal but very interesting account of the Yellowstone National Park, describing its most prominent physical features, geological peculiarities and scenic beauties, and a very enjoyable narrative of the adventures of his party during a camping tour in that "Wonderland" in July last.

Dr. O. D. Norton gave a description of a visit to the Alleghany region of Virginia, and particularly of the country adjacent to the Warm Springs and Healing Springs of Bath County, and presented specimens of the rock formations of those localities.

A vote of thanks was tendered Prof. Harper for his interesting and entertaining account of the Yellowstone National Park.

The list of donations was read and the Society adjourned.

LIST OF DONATIONS RECEIVED SINCE JUNE 3, 1890.

From Gustav Salzer: Dragon-fly, Hamilton County, Ohio.

Herbert S. Bridge: Moth, Hamilton County, Ohio.

Dr. S. C. Ayres: Janthine Shell, 2 specimens.

Percy Bryant: Tiger Beetles, 10 specimens, Kentucky.

Dr. J. A. Henshall: Fishes, 15 specimens, Ohio.

Ludlow Apjones: A copy of the Original Circular calling a meeting for the organization of the Cincinnati Society of Natural History. 1869.

Dr. O. D. Norton: Accretion, Warm Springs, Bath County, Va.; Rock Specimens, Blowing Cave, Bath County, Va.

Dr. A. B. Carnahan: Pre-historic Pottery, Greenup County, Ky.

Mr. Duverny: Butterfly Chrysalis, Hamilton County, Ohio.

M. B. Harker: Beetle, Hamilton County, Tenn.

Mrs. Sarah A. Kendrick: Beautiful Rosewood Cabinet, with a fine miscellaneous collection of Shells, Minerals, Fossils, etc.

Henry Voigt: Ichneumon Fly, 1 specimen; Fossil Fern, 2 specimens.

Dr. O. D. Norton: Ricolite (Mexican Variegated Marble), 1 specimen.

Cincinnati Zoological Society: 2 Australian Parrots, male and female.

L. A. Dunham: Miscellaneous Fossils, Hamilton County, Ohio.

Dr. Wm. Carson: Incrustations on Shells, Pebbles, etc., Crooked Lake, Michigan.

James B. Kemper: Double Hen's Egg; the enclosed egg with complete shell.

BOOKS AND PAMPHLETS.

H. P. Smith: Back numbers (9) of "Journal of Cin. Soc. Nat. Hist."

S. A. Miller, author: "New Echinodermata from Indiana, Missouri and Iowa," 1890.

Cincinnati University: "On Double Stars," 1890.

Prof. A. R. Crandall, author: "Kentucky Fossil Shells," 1890.

Mrs. Sarah A. Kendrick: "Geol. Surv. Ohio," Vol. III., "Geology;" *Ib.*, Vol. I., "Paleontology;" "Maps of Ohio Geol.

Surv.;" Lyell's "Elementary Geology," 1854; "Ohio Agric. Rept.," 1853; Lyell's "Principles of Geology," 1854; Dana's "Manual of Geology," 1862; "Report of U. S. Coast Survey," 1853.

Dr. F. Goppelsrœder, author: "Feuerbestattung," 1890.

Dr. Jules Rouvier, author "Identite de la Dengue et la Grippe—Influenza."

Henry Hemphill, author: "Catalogue of N. A. Shells," 1890.

Director-General: "Annual Statistics of Buenos Ayres," 1888.

Percifor Frazer, author: "Persistence of Plant and Animal Life Under Changing Conditions of Environment," 1890.

H. Garman, author: 1. "The Mouth-parts of the Thysanoptera;" 2. "A New Fresh-water Crustacean," 1890.

S. Waterhouse, author: 1. "The Westward Movement of Capital;" 2. "St. Louis as the Site of the World's Fair," 1890.

Jos. F. James, author: "On Variation; with Special Reference to Certain Palæozoic Genera," 1889.

Hon. Ben. Butterworth: "Report of Chief Signal Officer, 1887-88;" "Report of Chief Signal Officer, 1888-89;" "Report of Nat. Acad. Science, 1887;" "Earthworks of Ohio;" "Problem of Ohio Mounds," 1889; "Report of Smithsonian Institution, 1886;" "Bibliography of Iroquoian Languages," 1888; "Bibliography of Muskhogean Languages," 1889.

U. Hoepli, Milan, Italy: "Catalogue 67, 'Cryptogamia,'" 1890.

Alfred Nippert: 3 Volumes "Lepidoptera" (Impressions of both sides of wings), in addition to 5 volumes previously donated.

Wesleyan University, Middletown, Conn.: "19th Ann. Rep. of Curators of Museum."

CORRECTION CONCERNING *CASTOROIDES GEORGIENSIS*, SO CALLED.

The readers of the JOURNAL of the Cincinnati Society of Natural History may remember an article in a recent number (April, 1890), in reference to a supposed new species of rodent of great size.

I now owe it to the readers and to science to reconsider what was then published.

Fortunately it is not so difficult for a correction to overtake an error in the line of science, as for the truth to catch up with the lie in politics or the tale of scandal.

A large tooth, which was figured and described as the left upper incisor of a new species, *C. georgiensis*, has been pretty satisfactorily determined to be a right lower canine of a hippopotamus, and probably not a fossil at all.

I had on hand, at the time said tooth came under notice, the study of some fine newly-found incisors of *C. ohioensis*. The wonderful similarity of this Georgia tooth (said on good authority to have been dug from a forsaken gold mine) in certain respects, as curvature, fluting, finer surface markings, large persistent pulp cavity, reaching fully half the length of the tooth, and a crown beveled back at a sharp angle from the extremity of the outer curve, all conspired, with other points of similarity, to induce me to decide it to be a remnant of a very large rodent, probably a *Castoroides*, but very different from *C. ohioensis*, the only species known. I was confirmed in this view by a deservedly very high authority, who saw a pencil sketch, life size, and an excellent photograph, half size. These, of course, did not give him the advantage which a glance at the specimen would have furnished. I am mainly indebted to Prof. E. D. Cope, to whom I showed the tooth, for correcting my error.

It yet remains to search out the source of such a tooth from an unfrequented section of Northern Georgia.

JOSEPH MOORE.

NEW AND LITTLE KNOWN AMERICAN PALEOZOIC OSTRACODA.

By E. O. Ulrich.

(Read February 4, 1890.)

INTRODUCTION.

In offering the following extensive additions to the known forms of American Paleozoic *Ostracoda*, it may be in place to explain how it happens that my cabinet is so rich in a class of fossils that is usually but meagerly represented in even the best of our public and private collections. The last fact is no doubt due, primarily, to the small size of most of the forms, some of the species of *Leperditia* and *Isochilina*, only, being large enough to come within the observing powers of the average collector. By their mere abundance, some of the smaller forms have long ago forced themselves upon him, but the more modest majority require great care and more laborious methods than are now in common use, to obtain.

Most of the smaller species so far published and illustrated have been described by English authors, of whom Holl, Kirkby, Brady and Jones, the last particularly, have made the study of the *Ostracoda* a specialty.

The American material at their command was unfortunately rarely very ample, consisting only, in most cases, of specimens attached to slabs of shale and rock. Being unwieldy, these are often difficult to study, while important characters also may be hidden by the matrix. Their work, however, is as good as it was possible to make it under the circumstances, their descriptions being fortified by good illustrations, enabling the student to identify their species and varieties with comparative ease in nearly every case.

Good figures are an absolute necessity in the study of this interesting though difficult group of organisms. Where so much depends, as in these fossils, upon outward form and other peculiarities that must be expressed by terms having, perhaps, quite different values with different authors, and where there is often no little

uncertainty respecting the determination of the anterior and posterior ends, and, in some cases, even of the dorsal and ventral edges, it stands to reason that a single good figure is a more potent aid in the work of identification than a whole page of description.

But it requires no mean knowledge of the subject to make *correct* and *reliable* illustrations of the species, and as the English authors mentioned above were much more experienced than those American authors who have occasionally described species of *Ostracoda*, the obvious difference in the reliability of their respective illustrations is explained. This remark applies to my own early work as much as to that of others.

Two factors, then, may be said to have held the progress of the study of the *Ostracoda* of American rocks in check : the absence of interest and experience on the one hand, and a lack of sufficiently good and abundant material on the other. In my own case, I hope I may say truthfully that the, at least partial, removal of the first difficulty, resulted naturally from overcoming the second.

In my work on the *Bryozoa*, I have had occasion to institute washings of shaly and other soft or friable strata, that I might obtain the smaller forms in a free condition. In many cases the residue contained not only the desired *Bryozoa*, but numerous other small organisms, chief among them the separated valves, and often complete carapaces of *Ostracoda*. The task of picking the minute valves out of the material containing them is very laborious and trying to the eyes, the work having to be done under a lens. In each instance, therefore, only a small portion of the material was picked over, so as to furnish, as it were, a sample of the contents of each.

I had, besides, the advantage of benefiting from similar washings carried on by Prof. J. M. Nickles, Mr. Charles Schuckert and Mr. Ernst Vaupel, who very kindly turned small samples of their results over to me. Many of these remain as yet unpicked.

To Mr. Victor Lyon, of Jeffersonville, Ind., I am also indebted for a small quantity of fine residue from his extensive washings in the noted Devonian *Bryozoa* bed of the Falls of the Ohio. This proved quite rich, and went far to complete my own collections from that interesting locality. It is unfortunate, however, that Mr. Lyon and others who have made washings there did not save the fine sand left after picking out the *Bryozoa* and other fossils. Thousands of beautifully preserved *Ostracoda* were no doubt thrown

away with it. The small parcel received by me had been fortuituously overlooked, or it, too, would have shared the fate of the rest. Mr. G. K. Greene, of Albany, Ind., who also washed for *Bryozoa* at the Falls, saved some of the fine residue. He kindly picked out some of the *Ostracoda* and sent them to me for examination, but I found nothing among them not already known to me.

In this manner I succeeded in gathering a large series of these small fossils, and the supply of the apparently new forms is not by any means exhausted with the present memoir. No; many remain unworked, while another paper, on Minnesota species mainly, is almost ready for publication. And yet, the tide has probably only just begun to set in. Nearly every locality affords one or more forms not before noticed. Most of the species so far known, including those of this paper, are from the Trenton, Cincinnati, Hamilton and Chester Groups, with very few from below the Trenton, and not many from the Clinton and Niagara, the latter the equivalent of the English Wenlock that has proven so prolific in *Ostracoda*. Nor does the number known from our Carboniferous rocks at all compare with that described from European deposits of the same age. Here are numerous chances for the ambitious collector.

The accompanying plates are reproduced from pen drawings by the photo engraving process. With the exception of Plate XI, on which the outlines were obtained by means of dividers and measurements, all were drawn with the aid of a *camera-lucida*. No effort was made to produce either artistic or mechanical triumphs, but in every *essential* respect the figures are reliable.

The specimens used in the descriptions belong in every case to the author's cabinet.

The descriptions are grouped geologically, and under that zoologically as near as possible, into three parts as follows:

Part I.—Lower Silurian Species.

Part II.—Upper Silurian and Devonian Species.

Part III.—Carboniferous Species.

Part I.

Descriptions of Lower Silurian Species.

ENTOMIS MADISONENSIS, n. sp.

Plate VII, Figs. 12 *a*, 12 *b*.

Valves oblong-ovate, the back straight but short, the ends subequal and curved almost uniformly into the much more gently convex ventral edge. Sulcus deep, nearly central, extending from the dorsal edge fully two-thirds across the valve, bending forward a little at its lower extremity. Anterior half of valve moderately convex; posterior half more so, and rising abruptly from the sulcus. Surface smooth.

Size: Length, 1.3 mm.; height, 0.78 mm.

This, and a much larger form from the Niagara of Indiana, are the only species of *Entomis* at present known to me from American rocks. Though apparently a true species of the genus, *E. madisonensis* does not seem to be very closely related to any of the European forms.*

The strong sulcus will distinguish it from species of *Primitia.*

Position and locality: Rare in the uppermost beds of the Cincinnati Group, near Madison, Ind. It is associated with *Leperditia cæcigena*, S. A. Miller, and *Eurychilina striato-marginata*, S. A. Miller.

PONTOCYPRIS (?) ILLINOISENSIS, n. sp.

Plate X, Figs. 16 *a*, *b*, *c*.

Valves depressed triangular, with the angles rounded. Extremities subequal, but the anterior a little the widest. Ventral edge nearly straight, curving upward at the ends. Dorsal edge convex, most prominent a little in front of the center. Surface smooth, with point of greatest convexity a little in front of the middle, where a small spot differing in color from the remainder of the test is distinguishable.

Size: Length, 1.0 mm.; height, 0.5 mm.

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* The recently described *Entomis rhomboidea*, Jones (*Quart. Jour. Geol. Soc.*, February, 1890), from the Hamilton Shales, of New York, seems to me to be quite different from true *Entomis*, and probably congeneric with certain forms from the Devonian of the Falls of the Ohio, for which I shall propose a new genus.

This species belongs to a group of *Ostracoda* whose generic relations are exceedingly doubtful. I follow Prof. T. Rupert Jones' suggestion in referring this one to *Pontocypris*. My collection contains at least six others from the Trenton and Cincinnati rocks of Kentucky, Tennessee, Illinois and Minnesota, having, apparently, close relations to the form here described. One is a form like *Macrocypris vinei*, Jones, and two of the others are more like species that are referred to *Bythocypris*. I should have liked to work them out at this time, but as it was impossible to do them justice in the limited time at my disposal, I have thought it best to postpone their publication till the next opportunity.

Position and locality: The types of *Pontocypris* (?) *illinoisensis* were collected at Savannah, Ill., where they occurred in strata of the Cincinnati Group associated with *Primitia impressa* and numerous small *Bryozoa*.

CTENOBOLBINA, n. gen.

Carapace small, elongate-sub-oval, strongly convex, the posterior two-fifths more or less decidedly bulbous or subglobular, and separated from the remainder by a deep, narrow sulcus extending in a gentle curve from the dorsal margin more than half the distance across the valves toward the postero-ventral border. The anterior three-fifths often with another oblique but less impressed sulcus. Valves equal, the dorsal margin straight, hingement simple, the ventral edge thick, and the true contact margins generally with a row of small spines on each side; in a lateral view both are concealed by a "frill" or flattened border, usually mistaken for the true contact edges.

Surface generally granulose.

Type, BEYRICHIA CILIATA, Emmons (*B. tumifrons*, Hall). *Plate VII, Figs.* 1 *a and* 1 *b*.

This genus is proposed for the reception of several new species and two others that have been described as *Beyrichia*. The latter are *B. ciliata*, Emmons, and the closely related *B. duryi*, S. A. Miller, both from the Cincinnati Group. They are not, however, congeneric with *B. klœdeni*, McCoy's type of *Beyrichia*. True species of that genus have three lobes on each valve. These are variously modified, but usually consist of a small central one, and two, more ridge-like and often united, enclosing it. The posterior

lobe or ridge may be thickened, but this end of the carapace is never bulbous as in *Ctenobolbina*. Jones' and Kirkby's *Beyrichiopsis*, including Carboniferous species, agrees more closely, but is distinguished by a peculiar round lobe on the anterior half. *Beyrichiella* of the same authors, and likewise founded upon Carboniferous forms, resembles *Primitia* more than *Ctenobolbina*. Prof. T. Rupert Jones, of England, who is beyond question the best authority on fossil *Ostracoda*, agrees with me in regarding this as a good generic group, distinguished from allied genera by the bulbous character of the posterior end.

CTENOBOLBINA CILIATA, VAR CURTA, n. var.

Plate VII, Fig. 2.

This variety differs from the typical form of the species (see Plate VII, Figs. 1 *a* and 1 *b*) in being shorter, in having the posterior or principal furrow much narrower, and the central lobe produced above into a hollow, blunt spine. The flange or frill also is generally absent.

Size: Length, 1.19 mm.; height, 0.82 mm.

Position and locality: Found associated with *C. alata*, Ulr., in the lower shales of the Cincinnati Group, at Cincinnati, Ohio, about one hundred and fifty feet above the Ohio River.

CTENOBOLBINA CILIATA, VAR EMACIATA, n. var.

Plate VII, Figs. 3 *a, b, c*.

This is a strongly marked variety, differing from the more typical phases of the species principally in the ventral obsolescence of the anterior lobe, the greater obliquity and prominence of the central lobe, and the emaciated appearance of the valve between this and the rounded posterior lobe. The posterior sulcus is deep and very wide, and divided above by a slight elevation at the dorsal border. The surface granulations are also more minute, and arranged in crowded series. The flange is wide and smooth except at the edge, where there is a row of small spines.

Size: Length, 2.05 mm.; height, 1.24 mm.

Position and locality: Cincinnati Group, at Savannah, Ill.

CTENOBOLBINA ALATA, n. sp.

Plate VII, Figs. 4 *a, b, c.*

Carapace strongly convex, sub-oblong, obliquely ovate, straight on the back, elliptically rounded below, the ends strongly rounded, with the anterior one much the narrowest. Sulci very oblique, the posterior one well marked, the anterior scarcely perceptible. A strong wing-like process developed from the ventral prolongation of the anterior lobe. Flange well developed only in the older examples. Ventral and posterior edges very thick and concave beneath the flange; bordering the contact edges a series of blunt spines. Surface strongly granulose.

Size—	Length,	1.32 mm.;	Height,	0.71 mm.;	Thickness,	0.48 mm.
	"	2.0 "	"	1.15 "	"	0.72 "
	"	2.15 "	"	1.2 "	"	1.0 "

The alate processes, when fully developed, impart a rather grotesque appearance to this species. They are, however, easily worn away or broken, and, moreover, seem to be a rather variable feature, since in some examples, apparently in a good state of preservation, they are considerably smaller, and more spine-like than in those figured. In such cases the species is distinguished from *C. ciliata* and the closely related *C. duryi*, by the narrower anterior end, and greater obliquity of the valves. They are also more convex.

Position and locality: Lower shales of the Cincinnati Group, at Cincinnati, Ohio. The best examples were obtained from excavations along Brown Street.

CTENOBOLBINA BISPINOSA, n. sp.

Plate VII, Fig. 6.

Carapace rather strongly convex, sub-oblong, obliquely ovate, elliptically rounded below and straight at the dorsal edge. Posterior end wider and more abruptly curved into the ventral edge than the anterior. Free margins spinous, without flange, or with same very narrow. Surface of valves papillose. Anterior sulcus usually obsolete, the posterior one narrow, well defined, extending from the center of the dorsal margin in a slightly curved direction about two-thirds across the valve. Posterior lobe rounded; median and anterior lobes confluent. These conditions impart to the

carapace a decided resemblance to *Primitia*. Two long and delicate spines, one in the antero-dorsal fourth, the other near the ventral edge, a little in front of the center, suggest the specific name.

Size: Length, 0.91 mm.; height, 0.52 mm. Other specimens are one-third larger.

When typical, this species resembles certain forms of *Primitia* and *Beyrichiella* very greatly, but specimens in which the anterior sulcus is faintly developed are not uncommon. These, then, are very much like the young of *C. alata*, which species I regard as closely related. Indeed, I would not be surprised should a more complete series than is now in my collection show them to be but varieties of one and the same species.

Position and locality: Associated with *C. alata* in the lower shales of the Cincinnati Group, at Cincinnati, Ohio.

CTENOBOLBINA TUMIDA, n. sp.

Plate VII, Figs. 5a, 5b.

Carapace sub-oblong, erect, dorsal edge straight, three-fourths as long as the valves; ends subequal, the anterior often a little the narrowest, almost uniformly curving into the less convex, ventral edge. A narrow crenulated flange around the free margins. Posterior half of valves taken up by the remarkably tumid or subglobular posterior lobe. In front of this a strong depression cut off below by a narrow low ridge, the postero-ventral prolongation of the anterior lobe. In the depression between this ridge and lobe and the much more prominent posterior lobe, a small, narrow vertical lobe. Surface sloping rapidly down to the free margins. The test is not very well preserved on any of the numerous valves before me, but the best present evidence of granulations as in *C. ciliata* and other species of the genus.

Size: Length, 1.15 mm.; height, 0.7 mm.; greatest convexity of posterior half of single valve, 0.38 mm.; thickness of anterior half of same, 0.28 mm.

In the isolation of the small mesial lobe, this species approaches *Beyrichia*, but the posterior lobe is so decidedly "bulbous" that the generic reference can scarcely be questioned. The point referred to will at once distinguish the species from *C. ciliata*, its nearest known relative.

It should be mentioned also that in some examples the posterior lobe appears to be a little flattened on top, and the ventral prolongation of the anterior lobe forms occasionally a more pronounced ridge than shown in fig. 5*a*.

Position and locality: Middle beds of the Cincinnati Group, at McKinney's Station, Lincoln County, Ky.

TETRADELLA, n. gen.

Syn. *Beyrichia*, of authors (in part); *Strepula*, Ulrich (non Jones and Holl.)

This genus as now constituted comprises two distinguishable groups of species. The first and typical section may be defined as follows:

Carapaces somewhat oblong, often subquadrate, never tumid, with the hinge line straight. Surface depressed, with a semi-circular, narrow ridge rising abruptly from the free margins and running close to and nearly parallel with them, terminating at the posterior and anterior dorsal angles. In the enclosed space, two often slightly modified narrow ridges traverse the valves in a vertical or oblique direction from the dorsal edge, or from points near it, to the posterior half of the ventral portion of the sub-marginal ridge, uniting with it. The four vertical ridges of the dorsal half of the valves have suggested the name, but the fact that they all unite below is perhaps the most significant character of the genus.

Types: *Beyrichia quadrilirata*, Hall and Whitfield, Pal. Ohio, Vol. II, p. 105, Plate IV, figs. 6 and 7, 1875,* and *T. subquadrans*, n. sp.

Other species that should be placed here are *Strepula quadrilirata*, var. *simplex*, Ulrich, described from Manitoba, which proves to be a constant form, having lately been observed in considerable abundance on slabs from the upper beds of the Cincinnati Group, at Weisburg, Ind.; *Strepula lunatifera*, Ulr., and the following European species: *Beyrichia complicata*, Salter; *B. bussacensis*, Jones; *B. ribeiriana*, J., and *B. affinis*, J.

The second section, of which *Beyrichia oculifera*, Hall, and *B. chambersi*, S. A. Miller, are to be regarded as the types, differs

* More correctly figured and described in Contri. to the Micro-Pal. of the Cambro-Sil. Rocks of Canada, Pt. II, p. 54, Pl. IX, fig. 12. 1889. The author here erroneously refers the species to *Strepula*, Jones and Holl.

from the first in one respect only: The postero-dorsal extremity of the marginal ridge rises into a strong spine-like or otherwise shaped process. This process is always flattened either vertically or laterally, generally directed a little forward, and beaded on the edge. The postero-median ridge, though inclined to be variable, is, however, always present. And yet, in all the figures of *Beyrichia oculifera*, or *Tetradella oculifera* as it should now be called, so far published, the narrow sulcus separating it from the base of the high process is not represented. Even so experienced an observer as Prof. T. Rupert Jones, who lately published figures of the species (Quart. Jour. Geol. Soc., Vol. XLVI., Pl. IV., 1890), failed to see it. This may be due to the fact that the sulcus is usually filled with remains of the shaly matrix; or it may have been obscured by the shadow of the prominence just above it.

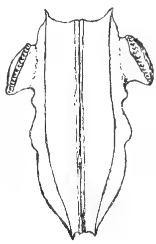

Fig. 1. Ventral edge of a complete carapace of *Tetradella oculifera*, (Hall). x 18.

The classificatory value of the elevated process that characterizes the second section of this genus is questionable. It is scarcely a feature of generic importance, yet, as its peculiarities in each of a number of species or varieties are remarkably constant, we are not justified in viewing it as a "mere ornament." At one time I thought of distinguishing the species generically as *Ceratella*, but further study has convinced me that such a division is unwarranted at the present time.

Taking the genus as a whole, its relations are perhaps nearest *Ctenobolbina*, the anterior half of the valves being sometimes much alike in the two. The posterior halves, however, are quite different, the bulbous character of that part of the carapace in *Ctenobolbina* having no representation in *Tetradella*. The ridges also are always more clearly defined in species of the latter.

In true species of *Beyrichia* there is no sub-marginal ridge, the

valves have a more tumid aspect, and the two or three lobes appear more like rounded prominences than ridges.

The "tri-sulcate" species of *Beyrichia*, the majority of which I believe ought to go with *Bollia*, are also related, but not so closely as may appear at first sight. In those species it seems to me the sub-centrally situated horse-shoe ridge characterizing the true *Bollia* is simply no longer fully developed, the definition of the sulci having gradually disappeared in the ventral half of the valves. In all species of *Bollia*, including the aberrant forms just alluded to, the central sulcus is approximately vertical, while the two lateral ones curve away from the center. In *Tetradella*, however, such a bilateral arrangement is not evident, since it is generally the case that *all* the sulci curve more or less anteriorly.

Species of this genus have a greater vertical range than is usual. Thus, specimens apparently identical with *T. chambersi* occur already in the Birdseye, at which horizon I collected them in Minnesota. I have not yet seen the typical form in the Trenton proper, but a variety in which the process is less spine-like and its fringed edge semi-circular, occurs in the upper beds of the Trenton and in the lower or Utica horizon of the Cincinnati Group

This variety probably foreshadows the *T. oculifera*, a form that is so far as known restricted to the uppermost one hundred feet of the strata exposed in the Cincinnati hills. Another variety of *T. chambersi*, differing from the typical Cincinnati specimens in having the two anterior ridges or lobes fuller, and the third or postero median one much larger than usual, occurs in the upper beds of the group at numerous localities. This form was illustrated by Hall and Whitfield, from Waynesville, Ohio (Pal. Ohio, Vol. II., Pl. IV, figs. 11, 12).

T. quadrilirata and *T. simplex* also occur in the Birdseye limestone of Kentucky and Minnesota, but appear to be absent in the beds intervening between that horizon and the upper two or three hundred feet of the Cincinnati Group.

TETRADELLA SUBQUADRANS, n. sp. or var.

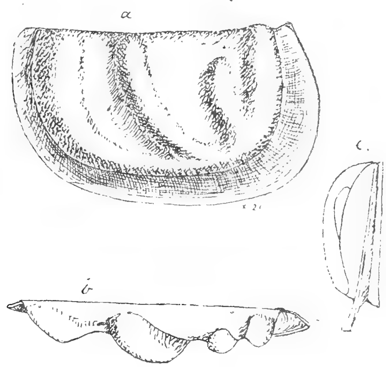

Fig. 2. *Tetradella subquadrans*, n. sp. or var. Trenton Group, Trenton Falls, N. Y.; *a*, left valve, x 20; *b*, dorsal view of same; *c*, posterior view of same.

Valves oppressed, slightly elongate, sub-quadrate, the dorsal edge straight, long, the posterior end vertical in the upper half, below bending rather sharply into the somewhat straightened or gently convex ventral margin. Anterior end oblique, rounding with a gentle uniform curve from the antero-dorsal angle to the center of the ventral edge. A wide concave border or "frill" around the free margins. The four ridges sharply defined, all connected, and seeming to spring from the postero-ventral region of the valve; the first or anterior ridge follows the curve of the ventral and anterior ends; the antero-median ridge, which is the most prominent portion of the valve, crosses it in a course nearly parallel with the first, terminating at the dorsal edge a little in front of the middle; the post-median ridge is short, directed only a little forward, and does not reach the dorsal margin the posterior ridge follows the posterior edge, thus completing the semi-circle begun by the anterior ridge.

Size: Length, including frill, 2.05 mm.; height, with same, 1.15 mm.; without frill, length, 1.65 mm; height, 1.0 mm.

This species is clearly distinct from all forms known from American deposits, but may be only a variety of the English Bala species, *Beyrichia complicata*, Salter. The American specimens differ in being more nearly quadrate, and in having the post-median ridge longer and farther separated from the posterior ridge. In any event the two forms must be closely related.

BOLLIA PERSULCATA, (Ulrich).

Beyrichia persulcata, Ulrich, Jour. Cin. Soc. Nat. Hist., Vol. II., No. 1, p. 12, Pl. VII, fig. 6, 1879.

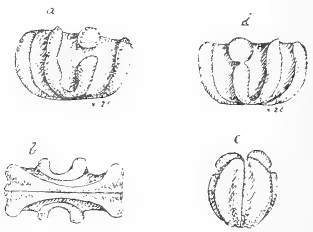

Fig. 3. *Bollia persulcata*, Ulrich; lower beds of the Cincinnati Group, Covington, Ky. *a*, left valve of the usual form, x 20; *b* and *c*, ventral and posterior views of same; *d*, right side of another carapace presenting slight differences, x 20.

This specimen is a true member of the group of *Ostracoda* distinguished in 1886 by Jones and Holl as *Bollia*. The posterior half of the horse-shoe ridge has its dorsal extremity separated as a rounded node projecting, like the other ridges, a little beyond the dorsal edge. Its bent ventral portion is thin and depressed, so that when the valves are attached to slabs, as is the case with the original examples, they usually appear as simply traversed by four slightly curved vertical ridges. In free examples, however, the true characters and forms of the ridges are shown as in the above figures.

Size: Length, 0.77 mm.; height, 0.45 mm.; thickness of closed carapace, 0.43 mm.

Prof. T. Rupert Jones lately referred an incomplete valve of this species to his *Beyrichia buchiana*, adding an interrogation point.* He admits that his specimen is "not well preserved," but overlooked, what I am confident he will find to be a fact, that the posterior lobe or ridge is broken away. Adding this ridge the valve would be identical in every particular with ordinary specimens of *Bollia persulcata*. His example, when complete, must have been more elongate than my original figure of the species (*loc. cit.*), and this fact probably misled him. But that figure is incorrect in its proportions, the height being too great, causing the valve to appear semi-circular, when it is really sub-oblong.

* Quart. Jour. Geol. Soc., Vol. XLVI., p. 16, Feb., 1890.

BOLLIA PUMILA, n. sp.

Plate XII, Figs. 1a, 1b.

Valves oblong-subelliptical, the anterior end somewhat narrower than the posterior, and with the point of greatest extension near the antero-dorsal angle; from here the edge curves backward into the uniformly convex ventral portion; posterior end rounded, nearly vertical, forming an obtuse angle where it joins the dorsal margin; the latter is never quite straight, but protrudes more or less in the central third of its length. A narrow ridge runs nearly parallel with the free edges, the abruptness with which it rises above them varying slightly. The ends of the inner or horse-shoe shaped ridge characterizing the genus, are bulbous and project a little beyond the dorsal margin; the curved portion thin, generally a little oblique, and well separated from the marginal ridge.

Size: Length, 0.86 mm.; height, 0.52 mm.

This species is smaller than usual in this genus. Its chief peculiarity is the bulbous enlargement of the ends of the horse-shoe ridge. It is too clearly distinct from *B. persulcata*, Ulr., to require comparisons.

Position and locality: Upper beds of the Cincinnati Group, near Weisburg, Ind., and other localities in Indiana and Ohio where equivalent strata are exposed.

DEPRANELLA, n. gen.

Carapace small, averaging 2.5 mm. long by 1.5 mm. high; subelliptical in outline; dorsal border straight, terminating abruptly at each end; ventral border nearly straight or gently convex, rounding almost evenly into the ends.

Running nearly parallel with the posterior and ventral edges, a sharply-elevated sickle-shaped ridge, often produced spine-like beyond the postero-dorsal border. Dorsal slope with two or more strong tubercles or ridges. At the ventral edge the two valves meet equally.

Type, D. CRASSINODA, n. sp.

The nodes on the dorsal slope and the greater size of the species referred to this genus distinguishes them from *Jonesella*.

Of described species, I know of only one having the characters of *Depranella*. This is the *Beyrichia richardsoni*, S. A. Miller, occurring in the upper beds of the Cincinnati Group. It has two

dorsal nodes or short, vertical ridges, and the sickle-shaped marginal ridge, which I regard as characteristic of the genus. A variety of *D richardsoni*, differing from the typical form of the species mainly in the more regular character of the superficial reticulation of the test, occurs at Oakville, Ontario, in purple shales, referred by the Canadian geologists to the Hudson River Group. It might be called var. *canadensis.*

The species of this genus are either few and very variable, or they are numerous and distinguished by slight differences. According to the view adopted, the forms named *ampla*, *elongata*, *nitida*, and *macer* will be regarded either as distinct species or all as varieties of *D. crassinoda.* A moderate and perhaps the proper view would be to place *D. nitida* and *D. macer* as varieties of *D. crassinoda*, and *D. elongata* as a variety of *D. ampla.*

Another species occurs in the Trenton shales of Minnesota. In this the marginal ridge is developed only along the ventral border. It will be described shortly, with other *Ostracoda* from the Northwest, in a bulletin of the Minnesota Academy of Sciences.

DEPRANELLA CRASSINODA, n. sp.

Plate VIII, Figs. 1*a*, *b*, *c*.

Valves sub-elliptical, dorsal edge straight, one-fifth shorter than the greatest length of the valves. Ends equally convex, rounding gently into the less convex outline of the ventral margin. Posterior and ventral margins very thick, rising at once into the strongly elevated, narrow marginal ridge. Four nodes rise above the general level of the but little convex space included between the dorsal edge and the marginal ridge. Three of these are on the anterior half of the valve; one small one, situated near the antero-dorsal angle, projects slightly beyond the dorsal margin. A second, much larger and very prominent node or ridge, extends from the dorsal margin half the distance to the ventral or marginal ridge. It has two apices, one of them projecting dorsally over the margin. Between this and the ventral ridge is another, crescent-shaped and only moderately high, but sharply defined, that extends from near the middle of the valve in a course nearly parallel with the antero-ventral margin. The fourth node, situated within the posterior half of the valve, is, more properly speaking, a strong ridge,

crowned with three small eminences. This ridge extends from the hinge line a little more than half the height of the valve toward the postero-ventral border. Surface smooth.

Dimensions of a complete carapace of the ordinary size: Greatest length, 2.55 mm.; greatest height, 1.6 mm.; greatest thickness of body, 0.6 mm.; thickness from summit to summit of marginal ridges near postero-ventral angle, 1.0 mm.

This fine species is represented by a number of specimens obtained from the Birdseye limestone at High Bridge, Ky. The next described is probably only a more tumid variety, and occurs at the same locality, but is from beds 275 feet lower, supposed to represent the Chazy limestone of New York.

DEPRANELLA NITIDA, n. sp. or var.

Plate VIII, Figs. 3a, 3b.

This species or variety of *D. crassinoda* differs from the typical form of that species principally in the plumpness of the valves and the great reduction in prominence and size of the nodes and ridges. The valves are so much deeper that we are forced to believe that there was some corresponding difference in the animals they contained. It may be noticed further that the carapace is shorter and not so high, and that the ventral edge is straighter than in the form called *D. crassinoda*. A well-preserved example has the entire surface between the nodes covered with an irregular delicate reticulation.

Position and locality: Chazy limestone, bottom of Kentucky River gorge at High Bridge, Ky.

DEPRANELLA MACER, n. sp.

Plate VIII, Figs. 4a, b, c.

This is another form that should perhaps be regarded as only a variety of *D. crassinoda*. However, comparison of the figures will show at once that it marks a sufficiently striking departure from the typical form of that species to deserve description and naming. Its characters are briefly as follows: Valves subquadrate, about 2.0 mm. long and 1.25 mm. high, with the body very thin and shallow, the thickness of the entire carapace at a point near the

middle being only about 0.3 mm. Ventral margin straight or sinnate; ends subequal, the posterior a little the most curved; postero and antero-dorsal regions angular, the angles ten or fifteen degrees greater than a right angle. Ventral edge slightly thickened. Marginal or sickle-shaped ridge high, projecting beyond the dorsal edge, running parallel with and very close to the abrupt posterior margin; then curving more rapidly than does the outline of the valve into the ventral margin, it gradually increases its distance from the ventral edge, and in a slightly flexuous manner traverses the valve for almost its entire length, terminating at a point near the middle of the anterior margin. Postero-median ridge consisting of three prominently confluent nodes, the uppermost projecting considerably beyond the dorsal margin. Antero-median node large, prominent and of triangular form. Antero-dorsal node projecting prominently beyond the edge, but not as high, and only about half as large as the antero-median one.

Position and locality: Safford's "Glade" limestone near Lavergne, Tenn. These beds may represent the Birdseye of New York.

DEPRANELLA AMPLA, n. sp.

Plate VIII, Fig. 2.

Valves subelliptical, comparatively ventricose, 2.5 mm. long by 1.5 mm. high. Ventral and dorsal margins sub-parallel, the latter straight, forming an angle with the posterior margin and rounding into the anterior end, which in its turn rounds with a somewhat more gentle curve into the gently convex ventral margin. Antero and postero-ventral regions equally curved. Dorsal end of the sickle-shaped marginal ridge projecting beyond the margin. From here it runs nearly parallel with the posterior and ventral margins of the valve. Two strong nodes on the dorsal slopes. The anterior one is very prominent and pointed, and projects obliquely outward and dorsally beyond the edge. The posterior tubercle is a little smaller and not so high, but otherwise similar. Between them a slight depression. Surface smooth.

In being rather ventricose this species resembles *D. nitida*, but differs in having only two strong nodes where that form has six to eight small ones.

Position and locality: Chazy limestone, bottom of Kentucky River gorge, at High Bridge, Ky.

DEPRANELLA ELONGATA, n. var.

Plate VIII, Figs. 5*a*, *b*.

This form differs from typical *D. ampla* in its outline, the dorsal margin not being terminated by an angle at its posterior end, and the whole carapace being longer in its proportion to its height. The length is 2.75 mm.; the greatest height, 1.36 mm. The dorsal nodes are also much less prominent, being, in fact, almost obsolete. On the other hand, the depression between them is better defined. The sickle-shaped ridge is also situated farther within the edge of the valves, and not quite as much elevated.

Position and locality: Chazy limestone bottom of Kentucky River gorge at High Bridge, Ky.; associated with *D. ampla* and *D. nitida*.

JONESELLA, n. gen.

Carapace small, ovate, moderately convex. Valves equal, their outline and general aspect much as in *Primitia*, Jones and Holl, but differing in having a simple or more or less divided prominent ridge on the posterior two-thirds. This ridge may be variously modified, but usually is bent like a horse-shoe, or the anterior half is straight and runs lengthwise across the valve.

Type, J. CREPIDIFORMIS (*Leperditia crepiformis*, Ulrich, Jour. Cin. Soc. Nat. Hist., Vol. II, p. 10, Pl. VII, Fig. 3, 3*a*, 1879).

The relations of this genus, which includes, so far as known, only Lower Silurian species, appear to be with *Bollia*, Jones and Hall, rather than with *Primitia* on the one hand and *Beyrichia* on the other. In *Bollia* the horse-shoe shaped ridge is centrally situated, while in *Jonesella* it occurs in the posterior half. In true species of *Bollia* there are also two vertical ridges running parallel with the ends of the valve. These are not represented in the new genus.

The generic name is given as a small compliment to Prof. T. Rupert Jones, of England. While paleontology is indebted to his careful and long-continued labors for the bulk of our present knowledge of fossil *Ostracoda*, I, personally, owe him much for kind advice and valuable suggestions.

JONESELLA CREPIDIFORMIS, Ulrich.

Plate VII, Figs. 8 *a, b, c.*

The illustrations on Plate VII. represent different views of a complete example obtained from washings of the lower shales of the Cincinnati Group made at Covington, Ky.

JONESELLA PEDIGERA, n. sp.

Plate VII, Figs. 9 *a, b.*

Carapace oblong, subquadrangular; ends rounded, usually subequal, but the anterior often a little the widest; dorsal edge straight, the extremities of same angular; ventral margin straightened in the middle, but curving neatly upward into the anterior and posterior edges. A very narrow flange all around. Surface of valves slightly flattened centrally, the slope being most abrupt near the margins. A faint depression is sometimes to be observed near the middle of the dorsal slope. The ridge is shaped like the head of a shepherd's crook, the bent portion being on the posterior half of the valve. It begins with a small, rounded knob a short distance in front of the center of the postero-dorsal fourth of the valve, then bending backward and downward proceeds toward the postero-ventral region, where with an abrupt curve it turns to proceed in nearly a straight line toward the center of the lower half of the anterior margin. The extremity of the ridge is often liberated, and projects as a blunt spine over the anterior slope.

Size of average specimen: Length, 1.05 mm.; height, 0.63 mm. Another valve, differing slightly in its outline, afforded the following measurements: Length, 1.15 mm.; height of anterior third, 0.65 mm.; height of posterior third, 0.73 mm.; length of hinge line, 0.8 mm.; thickness, 0.26.

The peculiar shape of the ridge in this species serves well in distinguishing it from all other *Ostracoda* known to me.

Position and locality: Rather rare in the lower shales of the Cincinnati Group, at Covington, Ky.

JONESELLA DIGITATA, n. sp.

Plate VII, Figs. 10*a, b, c.*

Carapace oblong, the length and height respectively as seven is to four; anterior half just appreciably wider than the posterior, or

with the dorsal and ventral margins sub-parallel. Dorsal edge straight and long, terminating abruptly, the antero-dorsal angle perhaps a little the most acute; ends uniformly and nearly equally convex; ventral edge very gently convex. Edges without a flange. Ridge large, peculiarly modified, digitate, and occupying nearly two-thirds of the surface of the valve. The posterior half is divided so as to appear like two fingers separated by a sulcus nearly as profound as the median one. The anterior half is wide and swollen on the outer side, while the ventral portion is thick and surmounted by a thin longitudinal crest.

Size: Length, 1.46 mm.; height, 0.82 mm.; thickness, 0.33 mm.

The outline of this species is not unlike that of *J. pedigera*, but the ridge in the two species is totally different. Indeed, some may be inclined to question that the two are congeneric, but I do not think such a doubt can prevail, since the next species is clearly intermediate in character.

Position and locality: I have seen only the example figured which I collected in Marion County, Ky., from the upper beds of the Cincinnati Group. The specimen is attached to a fragment of *Heterospongia*.

JONESELLA CRASSA, n. sp.

Plate VII, Figs. 11*a, b, c.*

Carapace oblong, widest posteriorly, slightly oblique, the anterior margin being most produced above the middle. Dorsal margin straight, the junction with the ends obtusely angular. Posterior edge uniformly convex, the ventral straightened in the middle. A well-developed flange around the free edges. Ridge loop- or horseshoe-shaped, oblique, very thick, the ventral portion overhanging the edge of the valve, the anterior arm very prominent below, bifurcating above, one division vertical and terminating knob-like on the dorsal border just in front of the center, while the other division soon becomes obsolete. The posterior arm, situated close to the margin of the valve, appears to consist of two parts toward its upper extremity, or as though one ridge was planted upon another, with the lower one extending almost to the dorsal margin.

Size: Length, 1.15 mm.; height, 0.72 mm.; thickness, 0.45 mm.

This well-marked species is intermediate in character between *J. crepidiformis* and *J. digitata*, the loop-like form of the ridge suggesting the former, while in the duplex character of the posterior arm it approaches the latter.

Position and locality: Trenton shales, Minneapolis, Minn.

PLACENTULA MARGINATA, n. sp.

Plate X, Figs. 13*a*, *b*, *c*.

Carapace small, vertically semi-ovate, very slightly oblique, with the dorsal margin nearly straight and about three-fourths as long as the valve. Cardinal extremities angular; ends of carapace subequal, curving neatly into the but little less convex ventral edge. A wide and sharply-defined flange forms the free margin; within this a thin, abruptly-elevated, wall-like ridge, nearly parallel with the outer edge. Body of valve with a faint, semi-circular elevation a little to one side of the center of the dorsal margin, enclosing the, in this species, undefined depression characterizing the genus. Around this elevation (beneath and on each side of it) the surface is slightly concave.

Size: Length, 0.52 mm.; height, 0.37 mm.

This and the succeeding species differ from the typical species of the genus in having the loop-like elevation or ridge and enclosed depression of the dorsal slope less developed. It is, however, scarcely to be doubted that they are true species of the genus.

The thin sub-marginal ridge and flat border of *P. marginata* are such distinctive features that the species is not likely to be confounded with any other known to me from the Cincinnati rocks.

Position and locality: Cincinnati Group; rare at Cincinnati, Ohio, where it occurs at the top of the hills.

PLACENTULA INORNATA, n. sp.

Plate X, Figs. 14*a*, *b*.

This species is in many respects like the preceding, but is longer, has the anterior end narrower than the posterior, and is without the thin sub-marginal ridge and flange. Instead, the mar-

ginal region is simply swollen and rounded off. The loop-like dorsal elevation also is situated a little farther forward.

Size: Length, 0.7 mm.; height, 0.4 mm.

Position and locality: Rare in the lower shales of the Cincinnati Group at Covington, Ky.

BEYRICHIA (? PRIMITIA) PARALLELA, Ulrich.

Plate X, Figs. 15*a*, *b*, *c and d.*

Primitia (*? Beyrichia*) *parallela*, Ulrich, Contr. to the Micro. Pal. of the Cambro-Silurian Rocks of Canada, Plate II, p. 51, 1889.

This species having been incorrectly illustrated in the work cited, and new and better specimens having been collected since from equivalent strata in Ohio and Indiana, new figures and remarks are now offered so as to complete the publication of the species.

Fig. 15*a* represents a nearly perfect left valve from near the top of the Cincinnati Group, at Richmond, Ind. It shows the strongly elevated posterior border,* less prominent and more rounded anterior margin, and a nearly distinct prominence in front of the sulcus that may well be regarded as representing the median lobe of *Beyrichia*. Hence the change in nomenclature proposed above.

The original specimens were from rocks equivalent to the upper beds of the Cincinnati Group. Others were obtained from shale washings at Oxford, Ohio.

EURYCHILINA, Ulrich, 1889.

This genus, together with two species, *E. reticulata*, the type of the genus, from the Trenton shales of Minnesota, and *E. manitobensis*, from rocks supposed to be equivalent to the upper beds of the Cincinnati Group, is described in "Contributions to the Micro-Paleontology of the Cambro-Silurian Rocks of Canada," Part II, p. 52. The generic description given there is as follows:

"Valves semicircular, sub-oval, or nearly circular. Dorsal line straight. Generally with a well-defined sub-central sulcus and a

* In the original work on this species the term "anterior" was applied to what I now regard as the "posterior" extremity.

more or less prominent node behind it. A very broad convex border extends around the valves from the antero-dorsal to the postero-dorsal angle. This border is often striated in a radial manner, and in most cases terminated by a marginal 'frill,' or by a plain narrow border, usually directed slightly outward. The main body of the border, however, curves inward to near the plane of contact between the two valves, thus forming a deeply concave outer area. Hingement simple. Surface reticulate, granulose or smooth."

Type, M. RETICULATA, n. sp. Trenton shales, Minnesota.

"This genus is related to *Primitia*, Jones and Holl, and to *Primitiopsis*, Jones. The possession of an internal concave marginal area separates it from the first, while the greater extension of the hollow area distinguishes it from the second. In *Primitiopsis* the marginal hollow is developed only at the anterior end."

EURYCHILINA SUBRADIATA, n. sp.

Plate IX, Figs. 1a, b, c, and 2a, b, c.

Valves semicircular, or elongate sub-elliptical in outline. Dorsal margin straight, nearly as long as the valves, terminating abruptly at both ends. Upper two-thirds of anterior margin straight, forming nearly a right angle with the dorsal edge, then curving gently into the slightly convex ventral edge. Posterior end evenly rounded. Body of valves semicircular, moderately convex, the point of greatest convexity along an obtuse ridge-like prominence (most distinct in the anterior half), running lengthwise across the central portion of the valve and from the summit of which the surface descends with a gently concave slope to the dorsal edge on one side and the beginning of the broad ventral border on the other. Sulcus deep and wide, beginning a little within the dorsal margin and extending half way across the body, its lower and posterior margins thickened and sharply defined. Just back of the sulcus a large round tubercle. Surface smooth. Marginal area wide, its width nearly equal all around, the widest portion in the postero-ventral region. In the antero-dorsal region it becomes separated from the body of the valve by the intervention of a narrow triangular depressed space. Inner edge of area abruptly elevated above the

body of the valve, then convex and marked with rather obscure radial furrows; with or without a narrow, flattened, terminal border.

Dimensions of a large right valve: Entire length, 2.25 mm.; greatest height (posterior half), 1.25 mm.; length of body of valve, 1.5 mm.; height of same, 0.9 mm.; average width of marginal area, 0.35 mm.; greatest width of same, 0.45 mm.; greatest convexity of single valve, 0.25 mm.

The absence of surface reticulation, pinched appearance of the central portion of the valves, stronger tubercle, wider sulcus and more abruptly elevated marginal area, together with other differences will readily enough distinguish the species from *E. reticulata.* The Manitoba species is more uniformly convex and has a narrower marginal area without radial striæ or furrows. In other respects it is closely related.

Position and locality: This species has a wide geographical distribution, but apparently is not abundant anywhere. I have specimens from Lower Trenton or Birdseye limestone at Lebanon, Tenn., Dixon, Ill., and Minneapolis, Minn.

EURYCHILINA LONGULA, n. sp.

Plate IX, Figs. 3 *a, b, and* 4.

Valves elongate, sub-elliptical, dorsal and ventral margins subparallel. Dorsal margin long, straight, the points of junction with the equally rounded ends not forming angles though quickly turning into them. Ventral margin gently convex. Body of valve semicircular or elongate subelliptical, moderately and nearly uniformly convex, with point of greatest convexity just below the well-defined and rather broad, but not deeply impressed mesial sulcus. Just back of the sulcus a broad and not very prominent tubercle. Surface smooth. Marginal area double and widest at the anterior end; at the ventral side its width is equal to fully one-fourth of the height of the entire valve. The folding of the area is characteristic. Beginning at the margin of the body it rises rapidly into a narrowly convex rim, from which it slopes down again only to be brought up once more by the development of a delicate "frill." Surface of marginal area without ornamentation of any kind.

Dimensions of a perfect but small right valve: Entire length,

2.2 mm.; greatest height, 1.1 mm.; length of body of valve, 1.5 mm.; height of same, 0.8 mm.; convexity of same, 0.25 mm.; width of marginal area at anterior extremity, 0.4 mm.; width of same at ventral and postero-ventral margins, 0.3 mm.

This species is more elongate than any of the others. The ogee molding of the marginal area also serves to distinguish it.

Position and locality: Birdseye limestone, at High Bridge, Ky.; and "Glade limestone," of Central Tennessee.

EURYCHILINA GRANOSA, n. sp.

Plate IX, Figs. 9, 10, 11 *and* 12.

Valves elongate-subelliptical; about 1.7 mm. long by 1.15 mm. high. Dorsal margin straight, often appearing a little convex, forming nearly a right angle with the anterior margin. This curves neatly into the convex ventral edge, and from there up again into the more rounded posterior end; scarcely forming an angle where the latter joins the dorsal margin. Body of valve strongly convex, with a rather narrow and deeply impressed mesial sulcus, and just behind it a prominent round tubercle. Central portion of surface with small yet quite distinct granules. Marginal area separated from body of valve by a sharply impressed line, convex, strongly bent in, typically smooth, and terminated by a narrow flange which in young examples is represented by a closely arranged row of small spines. Width of area greatest along the ventral border, where it is about 0.3 mm., becoming gradually narrower toward the dorsal angles, where it is less than half that width.

A variety, represented by figure 11, differs in having a more elongate form, stronger tubercle, and the marginal area covered with fine, interrupted concentric striæ. The marginal flange is also absent. It is associated with the more typical examples.

The tubercle, granulose surface, and narrower marginal area distinguish this species from *E. æqualis*. It is shorter, the tubercle stronger, and the marginal area differently curved than in *E. longula*.

Position and locality: Chazy limestone, bottom of gorge of Kentucky River, at High Bridge, Ky.

EURYCHILINA ÆQUALIS, n. sp.

Plate IX, Figs. 5, 6, 7 *and* 8.

Valves subelliptical to subcircular, equilateral; an average specimen 1.54 mm. long, and 1.15 mm. high. Body of valve strongly and uniformly convex, sub-elliptical in outline, 1.18 mm. long, 0.82 mm. high, and 0.3 mm. thick (*i. e.*, one valve only). Sulcus central, narrow, not very deep, nor extending to the dorsal margin. Marginal area strongly convex, widest at the ventral side, where it averages about 0.3 mm., becoming narrower gradually as it passes around the ends to the extremities of the dorsal line. No flange or frill is developed to interrupt its uniform convexity. Entire surface smooth.

The width of the ventral portion of the marginal area varies considerably in different individuals of this species. The extremes in this respect so far noticed are represented by the figures.

Compared with other species *E. granosa* probably offers the greatest resemblance. The absence of granulations, also of a node, and the less marked mesial sulcus, and more nearly circular form of *E. æqualis*, serve amply in discriminating between the two species. *E. subæquata*, a new species from Minnesota, has a granulose surface, a flat marginal area, and is slightly more elongate.

Position and locality: Chazy and Birdseye limestone, at High Bridge, Ky. Also at Lebanon, Tenn., where it occurs in the "Glade" limestone.

EURYCHILINA OBESA, n. sp.

Plate IX, Fig. 13.

Valves subquadrate, equilateral, strongly convex, about 1.5 mm. long and 1.0 mm. high. Dorsal margin straight, nearly as long as the entire carapace. Upper halves of anterior and posterior margins nearly straight, the angle of junction with the dorsal edge about 100°; below curving uniformly into the more gently convex ventral edge. Body of valve tumid, the entire surface granulose, with only an obscure, broad depression to indicate the usual median sulcus. Marginal area of nearly equal width all around, rather narrow, being only about 0.15 mm. wide. It is covered with closely arranged radial rows of very minute granules.

E. subæquata is more elongate, has a well-defined mesial sulcus, and coarser surface granulations. *E. striatomarginata*, Miller sp., is not so tumid, has a mesial sulcus and no surface granulation.

Position and locality: Birdseye limestone, High Bridge, Ky.

EURYCHILINA STRIATOMARGINATA, S. A. Miller.

Plate IX, Fig. 14.

Beyrichia striatomarginata, S. A. Miller, Cin'ti Quart. Jour. Sci., Vol. I, p. 233, 1874.

Mr. Miller's figure of this species being unsatisfactory, another one is here offered. Mr. Miller states that he found his specimens "in the upper fifty feet of the Cincinnati Group, * * * about three miles south of Osgood, Ind." My specimens are associated with *Leperditia cæcigena*, S. A. Miller, at the same horizon, several miles north of Madison, Ind.

PRIMITIA CENTRALIS, n. sp.

Plate X, Figs. 1 *and* 2*a*, *b*, *c*.

Carapace sub-oblong, the dorsal edge straight, the ventral elliptically curved, the anterior end somewhat narrower and more sharply curved, both ends meeting the dorsal edge without forming distinct angles; free borders with a narrow flange, best developed along the posterior edge. Sulcus represented by a sub-central depression, not reaching the dorsal margin. Surface smooth.

Size:— { Length, 0.6 mm.; height, 0.35 mm.
" 0.75 " " 0.48 "

This form is perhaps to be regarded as a variety of *P. humilis*, Jones and Holl, described from the Wenlock of England, but the slightly different outline, less abrupt posterior slope, more central and less deeply impressed sulcus, and more defined flange in the Cincinnati form are distinctions deserving recognition. Fig. 1 represents a larger variety in which the posterior half is considerably the widest, and the sulcus is situated nearer the dorsal margin. It might be separated, but, as many intermediate phases occur, it has not been deemed advisable to do so.

Position and locality: Not uncommon in the Utica shales near

low water mark in the Ohio River, in the vicinity of Cincinnati, O. The larger form (fig. 1) appears to be restricted to this horizon, but specimens like fig. *2a* occur, rather rare, it is true, in the limestone three hundred feet higher.

PRIMITIA PERMINIMA, n. sp.

Plate VII, Fig. 7.

A minute, short or broad-ovate *Primitia*, having the dorsal edge straight; the anterior end more narrowly rounded than the posterior, the ventral edge rather strongly curved, and the sulcus represented by a well-marked sub-central impression.

Size: Length, 0 34 mm ; height, 0.25 mm.

This species is in the main very much like the preceding, with which it is also associated, but being always much smaller and shorter, is readily distinguished. It should also be compared with *P. simplex*, Jones.

Position and locality: Occurs with *P. centralis* in the shales and shaly limestones of the Utica horizon at the mouth of the Licking River, Covington, Ky.

PRIMITIA IMPRESSA, n. sp.

Plate X, Fig. 3a, 3b, 3c, 4a, 4b and 4c.

A small, ovate species, rather tumid, with the dorsal and ventral margins nearly equally convex, and the ends equal, or the anterior slightly the widest. The free margins usually with an indistinct flange. Sulcus situated centrally, or a little in front of the middle, unusually deep, extending from the dorsal edge nearly half the distance across the valve, terminating abruptly. Just behind the sulcus a more or less faint swelling.

Size: Length, 0.6 mm.; height, 0.36 mm.

The valves of this species are more convex than those of *P. fabulina*, Jones and Holl, and *P. humilis*, Jones and Holl, to both of which it is closely related. Both of those species differ further in having the posterior end wider, and the point of greatest convexity further removed from the dorsal edge. There is no species known to me from American rocks resembling this sufficiently to make comparison necessary.

Position and locality: This species has till now been collected only at Savannah, Ill., in beds equivalent to the middle or upper portion of the Cincinnati Group. The specimens are associated with numerous minute bryozoa, of which *Trematopora (?) nitida*, Ulrich, and *Sceptropora facula*, Ulrich, are the most noteworthy.

PRIMITIA CINCINNATIENSIS, S. A. Miller.

Plate X, Figs. 5*a*, 5*b*, 6*a*, 6*b and* 6*c*.

Beyrichia cincinnatiensis, S. A. Miller, Cin. Quart. Jour. Sci., Vol. II, p. 350.

The original description and figure of this species are too indefinite for its identification, and, furthermore, since the species is interesting in this, that in some of its varieties a departure from *Primitia* toward *Klœdenia* and *Beyrichia* is indicated, it has appeared desirable to illustrate its peculiarities.

Fig. 6*a* represents the right valve of an average example, in which the flange is pronounced, the ends sub-equal, the sulcus deep, and the tumid regions on each side of it almost equal.

A left valve of a larger example, fig. 5*a*, shows some marked differences. The flange is narrow, and the tumid region in front of the strong sulcus has become separated to such an extent as to suggest the median tubercle of *Klœdenia* and *Beyrichia*. Of course, this departure from the typical form is very rare.

Size:—	Length,	0.6	mm.;	height,	0.38 mm.
	"	0.7	"	"	0.44 "
	"	0.82	"	"	0.51 "

Position and locality: Upper half of the Cincinnati Group. Mr. Miller collected his specimens near Weisburg, nearly three hundred feet below the Upper Silurian, while mine were collected at Clarksville, Ohio, in shales at least one hundred feet higher.

PRIMITIA MEDIALIS, n. sp.

Plate X, Figs. 7*a and* 7*b*.

Carapace oblong, most convex in the ventral and posterior regions; dorsal margin straight, but not terminating sharply at the ends; ventral outline evenly convex, rounding gently into the ends, of which the posterior is the most blunt. Dorsal slope

slightly depressed. Sulcus central, including a thin, sharply-defined mesial ridge. Surface smooth.

Size : Length, 1.14 mm.; height, 0.58 mm.

The thin mesial ridge is a peculiar feature. In other respects the species might be compared with *P. humilis* and *paucipunctata*, J. and H.

Position and locality : Upper beds of the Cincinnati Group, Jefferson County, Ky. The specimen illustrated is the only one seen.

PRIMITIA MILLERI, n. sp.

Plate XII, Figs. 2a, 2b, 2c.

Valves broad-ovate, the length and height respectively as two is to three. Ends subequal, the anterior sometimes slightly the narrowest. Free edges with an unusually narrow rim. Dorsal margin straight but short. Sulcus narrow, well impressed, not extending much over one-fourth of the height of a valve from the dorsal margin ; bending forward at its lower extremity. Surface rising higher and more abruptly on the posterior side of the sulcus than on the anterior. Point of greatest convexity very near the center of the posterior half.

Surface very finely reticulate, the meshes regular, mostly hexagonal, with a tendency to an arrangement in concentric lines observable.

Size : Length, 1.08 mm.; height, 0.76 mm.

Primitia bivertex, Ulrich, and its varieties, some of which resemble this species, have a more or less well-developed node on each side of the sulcus, and their shells are smooth. The valves of the new species, so long as they are in a good state of preservation, are not likely to be confounded with any other known to me.

The specific name is given for Mr. S. A. Miller, the author of the well-known work "North American Geology and Palæontology." He kindly loaned me the original examples of his *Primitia cincinnatiensis*, and in looking over the slabs for that form several valves of this species were also found. My own specimens are from Clarksville and Blanchester, O., from shales between two and three hundred feet below the top of the Cincinnati Group.

PRIMITIA GLABRA, n. sp.

Plate X, Figs. 9a, 9b and 9c.

Carapace comparatively large, moderately convex, the point of greatest convexity about the center of the posterior half. Hinge edge straight; anterior end semi-circular; posterior end somewhat oblique, very gently curved in the lower half, more abruptly in the upper; ventral edge gently convex; free margins with a moderate flange, widest at the ventral and posterior margins. Mesial sulcus represented by a broad, illy-defined and very shallow depression in the dorsal slope. Surface smooth.

Size: Length, 1.9 mm.; height, 1.17 mm.; greatest convexity of single valve, 0.45 mm.

This fine species belongs to a group of forms that approach *Isochilina*, the characteristic median sulcus of *Primitia* being almost obsolete. *P. valida*, J. and H., from the Wenlock of England, is another member of this group, and appears to be closely related to *P. glabra*, but differs in having a punctate shell, centrally restricted mesial depression, and the point of greatest convexity nearer the ventral edge. Of American species the Chazy group *P. logani*, Jones, may be compared. The dorsal notch in that species is, however, deeper, the shape of the carapace slightly different and the shell usually punctate. The outline of the anterior half in a ventral view, also shows the anterior slope to be more abrupt.

Position and locality: Upper beds of the Cincinnati Group, at Oxford and Blanchester, O. The species seems to be rare.

PRIMITIA NODOSA, n. sp.

Plate X, Figs. 11a, 11b, 12a and 12b.

This is a very neatly punctate species, having a straight dorsal margin, sub-equal ends, and nearly uniformly rounded ventral edge, with a distinct flange all around the free margins. There is no true sulcus; but the interval between two strong, rounded nodes situated one on each side of the center of the dorsal edge and projecting slightly beyond it, may represent the generic notch or sulcus. The anterior one of these knobs is the larger. A third node, smaller than either of those at the dorsal margin, occurs near the posterior edge, while a fourth rather inconspicuous eleva-

tion is found in the typical form of the species near the ventral border just beneath the postero-dorsal node.

In the slightly shorter variety, fig. 12*a*, the fourth elevation is missing, and the two dorsal knobs are less unequal in size.

Size— { Typical form: Length, 0.55 mm.; height, 0.34 mm.
The variety: " 0.48 " " 0.32 "

This species belongs to a group of species that ought perhaps to be distinguished generically from *Primitia*. All have two or more nodes, and are without a true sulcus. Of these species, *P. morgani*, Jones, is probably more closely related to *P. nodosa* than any of the others (*P. bicornis*, J., *P. æqualis*, *diversa*, *cornuta*, J. and H., etc.), but differs like the rest in wanting the third and fourth nodes, and also in being without a distinct flange.

Position and locality: The typical form occurs in the lower shales of the Cincinnati Group, in the vicinity of Cincinnati, O., from seventy-five to one hundred and fifty feet above low water mark in the Ohio River. The variety is rare, and was found only at one locality near the tops of the hills north of the city.

PRIMITIA NITIDA, n. sp.

Plate VIII, Fig. 7.

Carapace leperditoid in shape, the posterior half being much the widest and most prominent in the lower portion, the hinge line straight and terminating abruptly at each end, the ventral edge oblique and most curved in the posterior half. A well developed flange surrounds the free margins. Sulcus very shallow, situated on the dorsal slope, but not reaching the margin. A similar but even more faint impression beneath it. Surface finely pitted, most convex in the posterior half, slightly flattened centrally, and sloping gently toward the anterior end.

Size: Length, 1.05 mm.; height, 0.68 mm.

The pitted surface and narrower anterior end distinguishes this species from *P. centralis* of this paper. The English Wenlock species *P. valida*, J. and H., also has a pitted surface, but differs greatly in outline, the two extremities being almost equal.

Position and locality: The specimens are contained in a dark fragment of limestone which was used for ballast by the Kentucky Central Railroad. As near as I can learn, the material was derived from Upper Trenton strata near Paris, Ky.

PRIMITIA RUDIS, n. sp.

Plate X, Figs. 8a, 8b and 8c.

Carapace oblong, subelliptical, the two extremities nearly equal and most convex in the lower half; dorsal edge slightly convex; ventral margin gently rounded, almost straight in the middle third, with an indistinct flange. Sulcus rather wide, well impressed, but more sharply defined on the anterior side than on the posterior, extending from the dorsal border obliquely forward to the center of the valve. In front of the sulcus and between it and the dorsal margin, a faintly defined tubercle or lobe. Posterior half the most convex, the slope to the edge from point of greatest convexity, somewhat flattened. An undefined depression in the postero-cardinal region.

Size: Length, 1.0 mm.; height, 0.5 mm.

There is a rough and unshapely form and not a true species of *Primitia*. Its affinities seem to lie between *P. cincinnatiensis*, S. A. M., and *Beyrichia* (*? Primitia*) *parallela*, Ulr., in which case it would represent another link in the chain connecting *Primitia* and *Beyrichia*.

Position and locality: Rare at Covington, Ky., where it was collected from the shales of the lower one hundred feet of the Cincinnati Group.

PRIMITIA (?) SCULPTILIS, n. sp.

Plate VIII, Fig. 6.

Valves broad-oval or leperditoid in shape, the anterior end, though neatly rounded, much narrower than the posterior; in the latter half, from a point at about the center of the ventral edge to the subangular posterior extremity of the hinge line, the margin forms a semi-circular curve. In the anterior half the ventral border is less convex and slopes upward. Hinge line straight, the length equaling two-thirds the length of the valve, with the extremities obtusely angular. A depressed border, widest along the anterior and dorsal edges and very narrow at the ventral margin, encloses the elevated and coarsely pitted or sculptured main body of the valve. This is divided into two unequal lobes by a large sulcus, that is narrow and deepest above, but becomes shallow and much wider below the center.

Size: Length, 1.2 mm.; height, 0.84 mm.

Species of this and the *P. seminulum*, Jones, type, I can not regard as really belonging to *Primitia*, but I am not yet prepared to suggest a more fitting disposal of them.

Position and locality: Occurs in the dark Upper Trenton limestone at Perryville, Boyle County, Ky.

APARCHITES OBLONGUS, n. sp.

Plate X, Figs. 10*a*, *b*, *c*.

Carapace oblong, tumid, inequivalved, of irregular shape, widest posteriorly. Dorsal edge straight or faintly concave, rounding at the extremities. Anterior end semi-circular; the posterior most curved and prominent in the upper half, and much less curved and trending forward in the lower portion; ventral edge produced in the posterior half, straightened from there on anteriorly. Edges of valves irregularly thickened, apparently not overlapping. Surface smooth, glossy, most convex in the posterior half, the point of greatest convexity in the left valve being above the center, while in the right it is below it. The right valve is also much the most tumid in the ventral region.

Size: Length, 1.21 mm.; height, 0.8 mm.; greatest convexity, 0.78 mm.

The irregular, oblong shape of this species distinguishes it from all others known to belong to this genus. In *A. whiteavesi*, Jones, from the Lower Silurian of Manitoba, the edges are similarly thickened and fluted, but in other respects the two species are quite distinct, that one being almost sub-globular in shape.

Position and locality: Cincinnati Group, upper beds, at Middletown, Ohio. The species seems to be rare.

(*To be continued.*)

CONCERNING A SKELETON OF THE GREAT FOSSIL BEAVER, *CASTOROIDES OHIOENSIS.*

By Joseph Moore, of Earlham College, Richmond, Ind.

(Read by title, March 4, 1890.)

I. HISTORICAL INTRODUCTION.

In the fall of 1889, while some farmers in the eastern part of Randolph County, Indiana, were opening a very large ditch to drain a swampy tract, locally known as "the dismal," the contractor came upon a skeleton which, on account of its "standing in the natural position," and on account of its "wonderful tusks," awakened a desire to save all the parts that might be found.

The find proved on examination to be the bones and teeth of *Castoroides ohioensis*, Foster, which in the main were in a fair state of preservation. The finder, however, did not secure all the bones, and the earth which was thrown out was immediately scraped back and spread over the ground, from which a few additional fragments were afterward gathered.

The skeleton was found on the farm of Jno. M. Turner, formerly treasurer of the county. It was about eight feet below the surface, in a bluish gray silt, underlying four or five feet of alluvium very rich in vegetable mold.

Special interest must attach to this discovery, on account of the sparseness of the remains heretofore found. The approach to completeness of this skeleton may enable paleontologists to determine its zoological relations more confidently in some respects than they have been able heretofore to do.

As my readers are aware, *Castoroides ohioensis* has been known since 1838, when there fell into the hands of Col. J. W. Foster, an assistant of the Ohio Geological Survey, part of the lower jaw with the teeth, an upper incisor, and some other fragments which, from their resemblance to the corresponding parts of the beaver, led him to adopt the generic name *Castoroides*—the specific name being given owing to its then being known only from the State of Ohio.

Without stopping to note all the fragments that have come to the knowledge of specialists, let me here name the skull and right lower jaw which were found at Clyde, New York, in 1841, and which were measured and described many years since by Dr. Jeffries Wyman, of Harvard University.

All who are interested in the literature of the subject, and in the enumeration and descriptions of the parts heretofore known, may find what they desire in Coues and Allen's able Monograph on N. A. Rodentia, published in the U. S. Geological Survey of the Territories, Vol. XI, 1877.

Dr. J. W. Jay, of Richmond, Indiana, has a complete lower incisor, which was found near Greenville, Ohio, in company with mastodon remains, and was described by Dr. F. W. Langdon in the JOURNAL of the Cincinnati Society of Natural History, Vol. VI, p. 238.

A fragment of an incisor was found in Preble County, Ohio, a few years since, and another fragment near Richmond, Indiana; in both instances in connection with *Mastodon* remains.

The outer half of a right lower incisor was found several rods from the locality of the skeleton now under consideration, and in the earth from the same ditch. Said fragment is smaller than the corresponding portion of any of the other specimens herein named, and the crown seems to have been badly hacked and scarred by its opposing tooth.

II. ANATOMICAL DESCRIPTION.

As descriptions of the head have been ably given by others, I shall confine my account mainly to parts that heretofore have been but little or not at all known.

It may, however, be of interest to compare a few of the details of the jaws and teeth now before me, with the accounts given of the same by others, especially where there are slight differences, or where certain features may be better developed in this later find. As the common beaver is so well known, is accessible, and in many respects similar, it may aid both myself and my readers to make it a standard of comparison, aiming to show wherein the two species approach in structure and where they more widely differ.

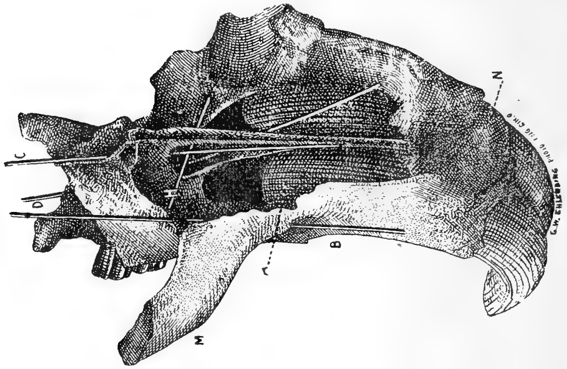

FIG. 1.—One-third natural size. Upper jaw with incisors: *a*, imbedded portion of incisors; *b*, straw passing through infra-orbital foramen; *c*, straw through upper posterior nares; *d*, straw through lower posterior nares; *h*, median partition; *m*, malar process; *n*, base of nasal opening.

The head of this specimen is very incomplete as regards the cranial region—the whole of the occipital, parietal and frontal regions of the cranium being wanting. Almost the only portions are the maxillaries, the premaxillary, palatine, right nasal, vomer, and enough of the forward portion of the sphenoid to show distinctly the anterior portions of the pterygoid fossæ. But the broken and defective condition of the skull throws some light on the internal structure. The nasal, frontal and ethmoid bones

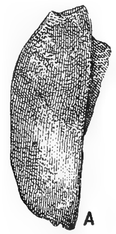

FIG. 2.—One-third natural size. Right nasal: *a*, anterior end.

being absent, except the right nasal, which is detached, the finely developed incisors are exposed as they curve backward through the premaxillary entirely to their bases. The full depth of the sockets is thus shown, and the hollow bases of the incisors are suffi-

ciently fractured to show the dimensions of the pulp cavities. The vomer is preserved and shows the well-defined groove of the upper margin for four inches or more.

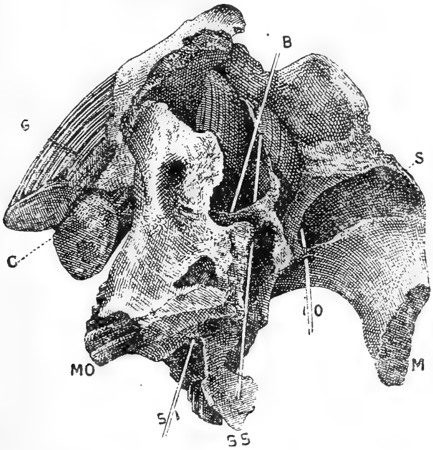

FIG. 3.—One-third natural size. Posterior, upper and left view of upper jaw: *c*, crowns of incisors; *g*, posterior groove of left incisor; *mo*, posterior left molar; *m*, malar process; *io*, infra-orbital foramen; *s*, ante-orbital sinus; *ss*, straw through upper posterior nares; *si*, straw through lower (triangular) posterior nares. Immediately above and on either side of this triangular opening may be seen the anterior portions of the pterygoid fossæ.

The large ant-orbital sinuses of the maxillary are well shown, through the bases of which the grooves pass backward from the infra-orbital foramina. Special attention has been given by Wyman, Allen and others to what is probably the most marked characteristic of the genus, namely, the double posterior nares, which results from "the extraordinary development and peculiar conformation of the pterygoid processes." Said fossæ would be two and a half inches deep in this specimen if they were complete. As it is, there remains on either side about an inch of groove. These two grooves indicate the lower portions of the fossæ. They extend forward and curve upward, giving us the bottoms of the fossæ, reaching anteriorly. We are here shown perfectly how the inner walls of the processes curve inward along the median line, till they coalesce at the surface of their adjacent convexities, and thus divide the posterior nasal opening into an upper and a lower. The lower opening is nearly an equilateral triangle, with the posterior margin of the palatine as a base. The upper opening, spoken of by Prof. Allen as "pyriform" (and

which was doubtless so where the borders were more nearly complete), is here more lenticular, being less than half an inch laterally and one and a half inches antero-posteriorly. The section of the same is diagonal from before backward and downward. The lower opening narrows rapidly forward until the right and left walls are scarcely more than a line apart. The upper channel has much the greater capacity for admitting air.

The greatest distance between the upper and lower channels, as shown here, is about three-fourths of an inch. At the point where the upper and lower openings come together, as they extend forward, there is a horizontal, top-shaped aperture in the bony partition separating the nostrils. This opening has the vertex forward, and is about one inch by five-eighths of an inch. It will be noted, then, that the air from either nostril can pass backward to the right or left, and both above and below.

The point where the double posterior nares joins the anterior is between and immediately above the bases of the incisors. The broad nasals and the wide area above the imbedded arches of the incisors and between the elevated margins of the premaxillary, give a good idea of the extent of the ethmoid region.

The right nasal bone is three and one-half inches long (with about a half inch broken off) by one and one-fourth inches broad. In *Castor*, *Fiber* and *Arctomys* the widest portion of the nasals is at or near the front, while here the widest portion is posterior to the middle.

The dentition is perfectly represented, for, though two grinders are lost from the right upper side and one from the left lower, yet the other sides are complete and perfect.

The dentition in general is superior to that of the Clyde skull as seen in Ward's cast. Especially is this seen in the upper incisors, the entire length of which, following the outer curve, is nine and one-half inches. They project from their sockets, measured on the front side, fully three and one-half inches. Posteriorly they are strongly braced and buttressed by a forward and downward projection of bony casing, which not only supports them on the lingual side, but thrusts in between and extends downward nearly to the backward border of the beveled crowns.

The same is seen in *Castor*, but it is even relatively greater in *Castoroides*. In the Clyde skull, the teeth, where they leave the sockets, are thrown half an inch apart by this interdental plate of

alveolus, and they are more than an eighth of an inch apart at their extremities. In this specimen they are one-fourth of an inch apart, and slightly converge till they touch at extremities. The longitudinally ribbed and fluted character of the incisors is here exhibited to perfection, as are also the numerous delicate wrinkles extending across the grooves. The number of longitudinal grooves, from the anterior inner angle round to the posterior sinus, is nineteen.

The beveled crowns are 1.37 inches in the antero-posterior diameter and one inch across, laterally. This, it will be noted, does not give the relative diameters of the teeth, since the crowns are worn obliquely. The circumference of these incisors taken together, two inches from the extremity, is 5.5 inches; circumference of one of them, 3.25 inches; lateral diameter of one, .96 inch; antero-posterior diameter, .85 inch.

They are covered with enamel anteriorly, on the distal surfaces, and as far around on the lingual side as the fluted surface extends. The proximal surfaces are slightly concave antero-posteriorly, and the lingual surface has a well-marked, shallow sinus, with the greater bounding ridge interiorly. There appears to be no enamel on the proximal, or on the adjoining surfaces of the lingual, sides. The lower incisors are 10.75 inches in length. They project 5.25 inches.

The proximal and lingual sides are flattish, with each a shallow longitudinal sinus, while the antero-distal side is convex, and has the fluted surface corresponding to the upper incisors, there being thirteen grooves near the crown.

In gnawing, while the upper incisors barely touched each other at their extremities, the inferiors must have powerfully pressed together and sustained each other, as their proximal surfaces, near their extremities, have worn each other away equal to one-fourth their lateral diameter, so as entirely to obliterate the mesial sinus for an inch or more. As these teeth approach each other in the two rami, and are crowded from their original direction by pressing together, their growth would be spiral if they could grow without wearing away at the crowns. I have before me an isolated left lower incisor which is clearly spiral. The antero-posterior diameter of these incisors, midway their free portion, is .87 of an inch; lateral diameter .75 of an inch.

The grinders are well known to be of special interest as affording

generic distinctions. In *Fiber* and *Arctomys* the lines of the series antero-posteriorly are nearly parallel. In *Castor* they converge rapidly forward. In *Castoroides* they converge still more rapidly, the distances anteriorly and posteriorly in the upper series being as one to three. As in *Castor*, the upper grinders slant backward and outward, while the lower slant forward and slightly inward. The leaning inward from a median line is less marked than in *Castor.*

The greatest length of the upper series along the crowns is 2.62 inches; length of lower series, 2.75 inches; length of anterior upper molar, 1.88 inches; length of posterior upper molar, 1.75 inches; length of anterior lower molar, 1.94 inches; length of posterior lower molar, .90 inch; antero-posterior diameter of crown of anterior upper molar, .62 inch; lateral diameter of crown of anterior upper molar, .65 inch; antero-posterior diameter of crown of posterior upper molar, .76 inch; lateral diameter of crown of posterior upper molar, .52 inch.

The grinders are made up of flattened enamel tubes enclosing plates of dentine. Said enamel tubes are held together by cement, otherwise they would be entirely distinct from each other from crown to base. While the disposition is to cleave into slabs on the decay of the cement, as in the grinders of the *Mammoth,* yet there is no common union of parts at the base as in the latter, nor is there anything approaching the nature of fangs.

They are set in the socket as a tenon in a mortise, showing the same unique folding at base as at crown. The flattened enamel tubes are hollow at base.

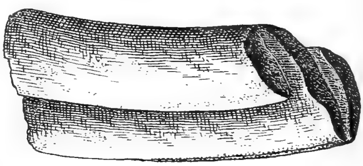

FIG. 4.—Natural size. Base of second lower left molar, showing entire absence of fangs, and also how the plated structure extends from crown to base.

For illustration, here is the middle enamel tube in the base of the second lower molar of the left side. It is a slit, less than a line wide and nearly three-fourths of an inch long, running diagonally across the base. A medium-sized needle probes these tubes from one-fourth to one-half an inch.

Each grinder is composed of three flattened enamel tubes,

except the anterior pair below, and the posterior pair above, in each of which there are four.

Each three-plated tooth has a deep vertical groove, interiorly, in front of the edge of the middle plate, and, exteriorly, behind the edges of said plate. These grooves being nearly opposite, give the crown of the tooth (or a cross section of the socket), the appearance of a depressed hour-glass, leaning to one side and having a very large opening from one chamber to the other.

In a lower series, the anterior and posterior teeth have about the same relative width across the crowns. In an upper series, the crown of the first molar is decidedly the widest, and they gradually narrow backward. The following cuts give the natural size of the right lower and left upper series, and the relative positions of the enamel, dentine and cement.

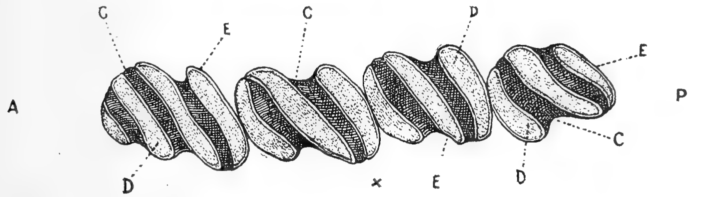

FIG. 5.—Natural size. Molars of left ~~upper~~ lower side: *a*, anterior; *p*, posterior; *c*, cement; *d*, dentine; *e*, enamel.

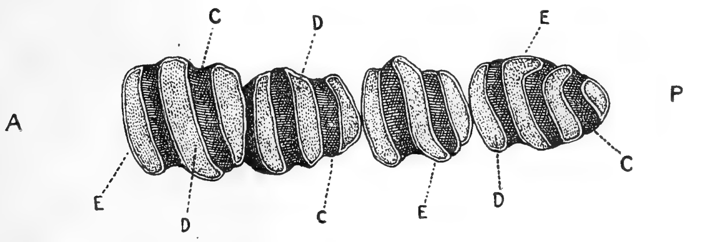

FIG. 6.—Natural size. Molars of left upper side: *a*, Anterior; *p*, posterior; *c*, cement; *d*, dentine; *e*, enamel rings.

As the ridges and depressions on the worn crowns run diagonally across, averaging an angle of about forty-five degrees, it gives the teeth the appearance of being twisted about one-eighth of an entire revolution. From the inner margins of the crowns the lines of fold extend outward and forward, both above and below.

The folds, as seen in the cuts, are not uniform as to thickness,

width or distance apart. One edge of a cement plate may be several times thicker than the other, and in more than one case, as at x, fig. 5, the flattened enamel rings in the crowns, unless carefully examined, appear to be confluent.

The lower series, on either side, is slightly concave antero-posteriorly, corresponding to an equal convexity in the upper. The upper grinders slant and curve outward and backward; the lower slant inward and forward, though the first, toward the crown, bends slightly backward.

The upper projects about equally from the alveolus all along. Below, the fourth is barely above the alveolus rim, but they rise gradually forward, till the front border of the first stands out more than a half inch.

The distance from the inner curve of the upper incisors to the crown of an anterior molar is 4.12 inches, which is .25 of an inch greater than in the Clyde skull.

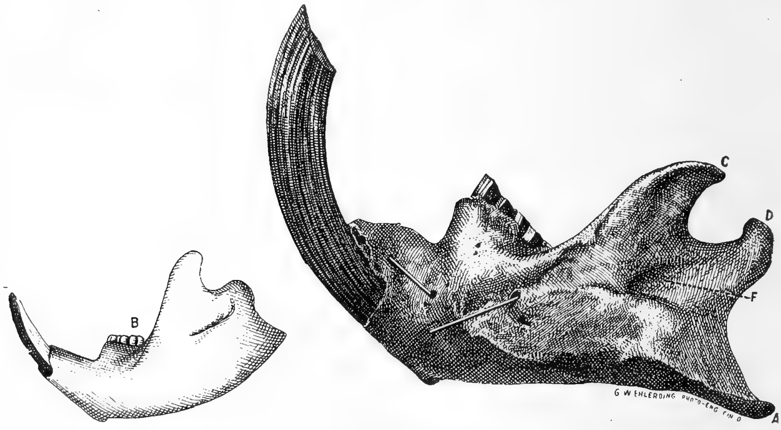

FIG. 7.—One-third natural size. Lower jaw, exterior view: *a*, angle bent downward and inward; *c*, coronoid process; *d*, condyle, bent inward; *f*, fossa for attachment of muscles Straws show foramina. *B*, Outline of lower jaw of *Castor*, same scale.

The massive look of the lower jaw, with its many prominent features, arrests the attention of the most indifferent observer. Its weight, after lying in a dry room for five months, is one pound and twelve ounces avoirdupois.

It can hardly be needful to describe in full detail what specialists have heretofore had in hand. Some account may, however, be of

interest and convenience to such as may not have easy access to more full and complete descriptions.

This rodent's lower jaw is wider than long, leaving out the incisors in the measurement; its antero-posterior extent being 7.55 inches, and its lateral 8.40 inches. The greatest width is an inch or more forward of the posterior extremity of the incurved angles. The rami being disconnected, the large area of the symphysis, with its ribbed and tuberculated surfaces, is clearly shown.

Placing the left ramus beside the corresponding part of a well-developed *Castor fiber*, the process at the lower posterior point of the symphysis in the one, is very similar to that in the other, and about equally prominent in proportion to size.

Holding each ramus in a horizontal position, teeth upward, the posterior third in *Castor* bends upward and gently inward, and from the angle a posterior and upper border reaches forward directly to the neck of the condyle. In *Castoroides* the posterior (less than) half of the ramus bends downward, abruptly outward, then sharply inward, terminating in the incurved twisted angle; while between this prominent angle and the neck of the condyle is a notch in the posterior border 2.5 inches wide by one inch deep.

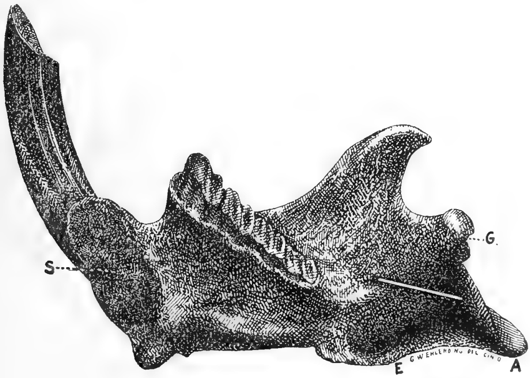

FIG. 8.—One-third natural size. Upper and inner view of right ramus. Note grooves on the proximal and lingual sides of incisor, and worn inner surface.
a, Angle showing inward bend; *e*, the S-shaped plate with fossa for pterygoid muscle above; *g*, groove in posterior side of condyle and neck; *s*, symphysis.

Probably the most extraordinary feature of this bone is the internal pterygoid fossa, which is well shown in the illustration, bounded at the bottom by an S-shaped blade .75 of an inch wide,

projecting inward and backward from the postero-interior base of the ramus. Another notable feature is a large external fossa below the sigmoid notch for the insertion of the masseter muscle. The depth of this fossa is largely due to the swelling outward, immediately below it, of the lower part of the ramus in that region, to accommodate the base of the deeply-planted incisor.

The coronoid process in *Castor* stands well above the nearly sessile condyle, making the sigmoid notch comparatively shallower. Said process is relatively greater than in *Castoroides*, but not so much so as might at first appear, since the relatively greater length of the condyle in *Castoroides* is so marked as to make the process *comparatively* low. The condyle, with its neck, is more than 1.5 inches long, measuring from the level of the bottom of the sigmoid notch. The condyle has a wide and well-marked groove posteriorly, which is barely perceptible in *Castor*. Owing to the bending inward of the ascending rami and the necks of the condyles, the inner faces of the latter look toward each other (as well as upward) and stand less than 2.5 inches apart, which is relatively much less than in *Castor*, and indicates how narrow was the brain cavity for so large an animal.

The mental foramina are immediately below the anterior molars, but quite above the upper line of the imbedded incisors. Nearly an inch backward from the posterior molars, and in the base of the ascending ramus, is the dental foramen, of the diameter of a rye straw. Below this, along the deepest groove of the pterygoid fossa, is a line of half a dozen or more small foramina which probably lead to the pulp cavity of the posterior incisor at its base.

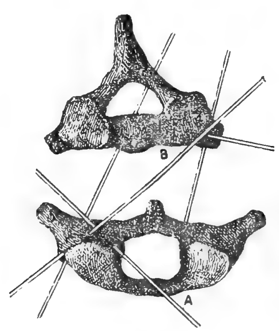

FIG. 9.—One-third natural size. *a*, anterior and upper view of atlas: straws indicate the foramina and their directions; *b*. anterior view of axis.

The atlas, while it bears a general resemblance to that of *Castor*, is, in some important respects, different. The lateral diameter, including processes, is 3.62 inches; from tubercle to extremity of spinous process, 1.75 inches; across anterior articular surfaces, 2.37 inches; posterior articular surfaces, extreme diameter, 2.12 inches; vertical diameter of neural arch, 1.12 inches; lateral diameter of neural arch, 1.06 inches.

The area below the transverse ligament appears to be relatively greater than in *Castor*, and that above the ligament relatively less.

The anterior articulating surfaces, which articulated with the occipital condyles, show that there was less of the ball and socket character than in *Castor*, as their transverse areas are relatively greater, and their depth relatively less.

The neural groove above and anterior to the posterior articulating surfaces is deep and very narrow, so much so that it is almost a neural foramen. The lateral processes are much less flattened and wing-like, less bent upward and backward, and the spinous process is more developed than in *Castor*. The foramina are indicated by the straws in the illustration, and for number, position and direction, correspond very nearly with what one may see in the atlas of *Castor*. The spinous process is about one-fourth of an inch long, with an anterior groove and perceptibly double at the extremity.

The axis and the third cervical are so thoroughly anchylosed as to be one solid piece. This double character was not discovered till an effort was made to homologize the foramina and other parts with the same in other rodents, but the neural foramina at the sides, the double character of the transverse processes and various other marks make its character very clear. The neural arch of this double vertebra is nearly semicircular, being one inch transversely at the base, and half an inch vertically. From lower surface of centrum to tip of spine is 2.12 inches. Between extremes of transverse processes, 2.85 inches.

In *Castoroides* the transverse diameter of the axis is almost equal to that of the atlas, while in *Castor* it decreases to little more than half the lateral extent. The lateral processes are bent downward, as well as backward. The anterior articulating surfaces are perceptibly convex, and are laterally .85 of an inch, by .75 vertically. They slope backward at an angle of about forty-five degrees.

The third cervical (fused to the axis) measures 2.12 inches

across the posterior articulating surfaces, which are decidedly concave, vertically, and look far more directly backward and less downward than in *Castor*. The arterial foramina pass through the double tranverse processes and form a notch in the lower posterior margin of the anterior articulating surfaces. The remaining four cervical vertebræ are missing.

The length and general bulk of the spinal column, from the sacrum to the atlas, does not differ much from that of an adult man, being about twenty-one inches in length. It is difficult to determine the exact length, as some pieces are missing and the epiphyses are nearly all absent. There were fourteen thoracic vertebræ, nine of which had transverse processes. This is evident from the fact that there are nine ribs on one side having tubercles.

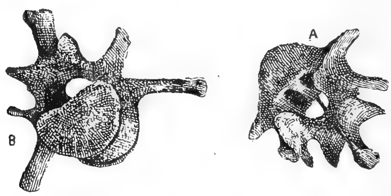

FIG. 10.--One-third natural size. Two dorsal vertebræ near the lumbar region: *a*, anterior and upper view. Note the pits in base of neural arch; *b*, posterior, under view.

The lumbar vertebræ are five in number, and the sacral four—these divisions corresponding to *Castor*. The centra are porous and spongy to a degree not often met with. At the base of each neural arch (upper side of centrum) is a pair of pits, or foramina, which appear to open into the more spongy interior. These are easily seen in *Castor*, *Arctomys*, *Fiber*, and probably many other genera, but here they are conspicuous to a marked degree. In the cervical region they are comparatively small and remote, on opposite sides of the median line. They are larger and nearer together in the middle dorsal region, while in the lumbar region they occupy the whole floor of the arch, separated only by a thin blade, and are large enough, each, to hold a fair-sized bean. Split a black walnut, remove the kernel from the divisions of one of the halves, and we have similar-looking cavities. The posterior thoracic, and the lumbar vertebræ, are coarsely punctured on the under side — one or two of the lumbar to such an extent and so irregularly as to give them a worm-eaten appearance — some of the foramina having the diameter of a small goose quill.

The spinous processes slant backward, as in *Castor*, till we reach the tenth thoracic, which is vertical. Those back of this slant more or less forward. The third and fourth lumbar spines are the longest in the series, and slant forward nearly forty degrees, which is more than in *Castor*. There is no marked difference in the length of the neural spines from the fourth thoracic back to the sacrum. They are relatively short, and in the lumbar and posterior thoracic they are quite wide antero-posteriorly. In *Castoroides*, *Arctomys* and *Fiber* said spines are wider than the intervals between, while in *Castor* the spaces are wider than the spines. The intervertebral foramina are relatively small.

The lateral diameter of the first thoracic vertebra, including transverse processes, is fully three inches, and the distance between outer edges of anterior zygapophyses of the same is half a line less than two inches. These transverse diameters diminish backward to the fifth. The transverse processes from the fourth to the ninth are double — the lower process having a facet to fit the tubercle of a rib — the upper process bending upward, slanting backward, and the tips of some of them turning inward as in *Castor*, but the upper portion is broader and more wing-like than in said genus.

The tenth, eleventh and twelfth have no lateral processes proper, except so many barely distinct prominences. It would be difficult to conceive a better example of compactness, or a nicer provision for firm interlocking, combined with ample bending and twisting, than we have in the region from the twelfth to the fourteenth.

The articulating facets are much curved laterally and fit very closely. The anterior zygapophyses are clasped between the posterior zygapophyses, on the one side, and the strong, styloid, backward-projecting anapophyses on the other; somewhat as if pinched between a thumb and finger. The anapophyses fade out with the second lumbar, as in *Castor*.

The flattened, horn-shaped lateral processes of the fifth lumbar curve forward about an inch, and a little downward. They measure from tip to tip 3.55 inches; lateral diameter of centrum, 1.75 inches; vertical diameter of centrum, 1.12 inches; length of neural spine, 1.25 inches.

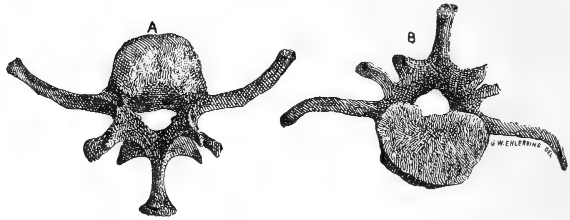

FIG. 11.—One-third natural size. Two lumbar vertebræ: *a*, The third, anterior view, showing pits in base of neural arch; *b*, the fourth, posterior view, the epiphysis wanting.

The transverse processes of the third and fourth lumbar are much broader, and are more bent forward and downward. The longest neural spine is the fourth lumbar, and it slants more to the front, is 1.36 inches long, has a sharp blade in front, is one-fourth of an inch thick at its posterior middle, and at upper extremity is .62 of an inch across, and one inch antero-posteriorly.

The neural arch is decidedly flatter, on an average, than in *Castor*, is more nearly triangular, and approaches less to a semicircular outline in section.

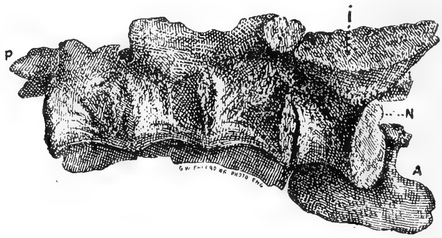

FIG. 12.—One-third natural size. Under surface and right margin of sacrum: *a*, anterior view; *n*, neural arch; *i*, articular surface for innominate bone: *p*, posterior zygapophysis.

The sacral vertebræ are four in number, measuring unitedly along the median line 5.12 inches. The width anteriorly is 4.12 inches. The thin, blade-like transverse processes of the second, third and fourth are broken off about midway, outwardly. In *Castor* and *Fiber* the four exposed transverse processes blend into a continuous wing, which widens backward, and warps upward, more in *Fiber*, less in *Castor*. These blades have large perforations opposite the planes of union of the coalescing centra. These perforations increase in size from before backward. The spinous processes also coalesce into a blade with a continuous thickened crest. This,

also, has three large transverse openings, but they *diminish* from before backward. In *Castoroides* more than enough of the transverse blades is left to show the perforations corresponding to those in the genera just named, and, as in the others, the openings increase in diameter from before backward. That these side blades widened backward is almost certain from the length of the transverse processes of the first caudal vertebræ.

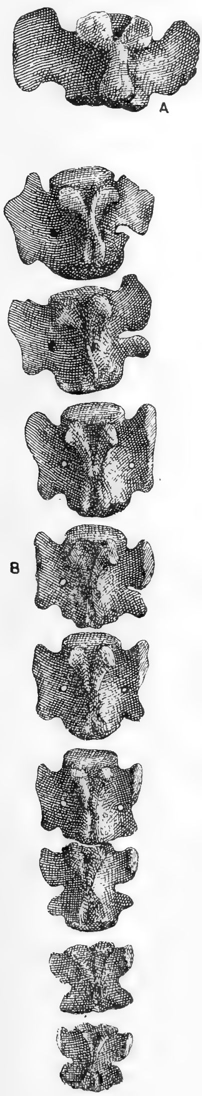

FIG. 13.—One-third natural size. Caudal vertebræ, upper side: *a*, the seventh; *b*, a series including ninth to seventeenth. Note the broad transverse processes, some perforate, some notched, others bifurcated.

The articular surfaces, by which the sacrum joined the innominate bones, involves the transverse processes of the first vertebra, and over half an inch of the second. The entire articular surface is 2.75 inches antero-posteriorly, by 1.12 inches vertically, at the widest part. It is difficult to tell just how much of the frail margin has been broken off.

Of the caudal vertebræ, fourteen have been found. These, laid together in their order, making fair allowance for the absence of a number of the epiphyses, measure 21.75 inches. As there are three or more missing in the region from the fifth to the eighth, the fourteenth in hand is about the seventeenth in the whole series. The abruptness of the termination at the seventeenth makes it, as compared with the *Castor* and *Fiber*, seem very probable that the whole number was not less than from twenty-three to twenty-five. This would give the entire estimated length of the tail very nearly thirty inches, very likely more than less; and the entire length of the skeleton, say, five feet nine inches.

The centrum of the first caudal is 1.25 inches laterally, by 1.12 inches vertically, on the anterior surface, the posterior surface being perceptibly greater. These articulating surfaces are quite convex,

with an oval depression a little above the center. Farther back in the series the depressions are central and circular.

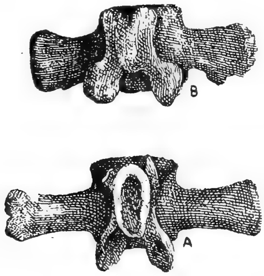

FIG. 14.—One-third natural size. Caudal vertebræ, upper side: *a*, the first; *b*, the fifth.

The centra are the longest in the region of the tenth to the fourteenth, as in *Castor*. The eleventh is 1.75 inches. They are not flattened vertically, as in *Castor*, till we reach the seventeenth, the distal end of which is .66 of an inch laterally, by .65 vertically.

The neural spines are proportionally of about the same length as in *Castor*, and fade out backward, disappearing in the eighth or ninth. They are relatively thicker and stouter in *Castoroides*, the first being more than half an inch thick at the summit, and 1.12 inches antero-posteriorly.

The transverse processes are relatively shorter than in *Castor*, and have not on their outer extremities the spurs or spines, which are a marked feature of a few of the forward tail vertebræ of well-matured specimens of the latter.

They are not directed backward, as in *Castor*, from the third to the seventh, but are deeply notched or falcate on the anterior border next the centrum, from about the fourth to the twelfth. In this lateral feature the genera are similar. There is also a marked similarity in the broad, wing-like, bifurcate character of the transverse processes seen from the ninth to the twenty-second in *Castor*, and from the ninth backward in *Castoroides*. As a rule, the anterior division of the flattened lateral process is much larger, and is directed forward, while the smaller is directed backward. These are particulars which are liable to differ in the same species, but as none of my readers may have seen the tail of *Castoroides*, it may be of value to notice the particulars, especially as this part of the skeleton is indicative of the creature's habits.

In the ninth and tenth, the left wing-like process is merely perforated next the centrum, while on the right there is a slit from the corresponding foramen to the margin. The eleventh has the foramen on either side, with a groove in place of the slit. The thirteenth and fourteenth have each the foramen in the left wing, and an elongated foramen, followed by a groove, which leads to a notch in the margin. Numbers fifteen, sixteen and seventeen have each the regular cloven character, the divisions diverging from the centrum outward.

The lateral processes are, as a rule, relatively much thicker (except in the first three or four) at their outer extremities, than in *Castor.* This is especially so at the anterior borders of the broad processes, which are often bent somewhat downward. Without these wing-like processes the tail would not present any flattened appearance, save near the extremity where the centra are slightly compressed vertically. The posterior half of the tail is strikingly similar in general appearance to its counterpart in *Castor*, whether seen from above or below.

No chevron bones are preserved, but the prominent processes on the under side of all the anterior caudals seem clearly to indicate that they were there in full size. The median longitudinal groove on the under side is very strongly marked.

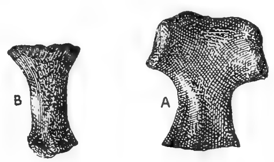

FIG. 15.—One-third natural size. Sternum: *a*, anterior piece: *b*, posterior extremity.

Of the sternum but two pieces, the pre-sternum and the xiphi-sternum, were obtained. The former is 2.18 inches long, 2 inches wide anteriorly, 1.25 inches wide posteriorly, .87 of an inch wide near the middle, and is .5 to .75 of an inch thick. This piece is relatively more massive than in *Castor*, and differs materially in form. The xiphi-sternum is quite similar to its counterpart in *Castor*, but is relatively somewhat shorter.

Of the ribs, there are eight right and twelve left, which is probably within two of the full number of the latter. Nine of them are distinctly tuberculated, but the tenth is not. The length of the

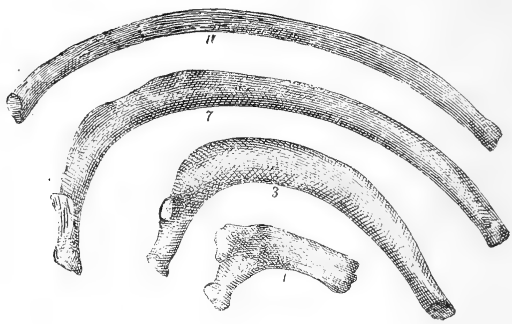

FIG. 16.—One-third natural size. Ribs of right side, first, third, seventh and eleventh.

first from the middle of tubercular facet to sternal extremity is 2.25 inches, which is relatively short. The fifth, between the same points, is 7.12 inches, while the seventh, along outer curve, is 10.25 inches. From center of head to center of tubercle of the first rib is one inch, which is very nearly the same distance as in the corresponding points throughout the series. The ribs, in general, have the muscular impressions and processes, and also the angles, strongly marked. Their surfaces, in the main, have a crumpled and reticulated appearance.

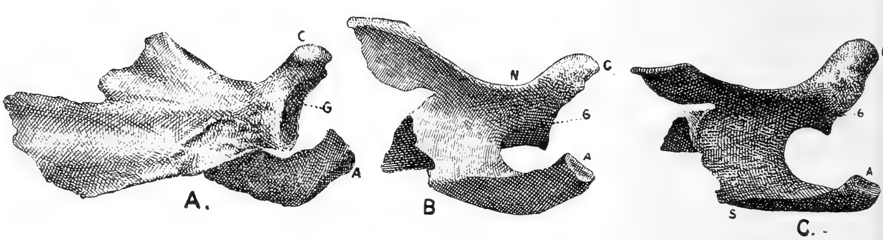

FIG. 17.—One-third natural size. Scapulæ: *A*, inner face of left; *a*. acromion; *c*, coracoid process; *B*, external view of right; *n*, neck and supra-scapular notch: *C*, right scapula resting on edge, showing height of spine.

The scapulæ, though badly broken, retain their more important points. The longer diameter of the glenoid cavity is 1.37 inches, or about the same as in man. The shorter diameter is .87 of an inch, making the two distances as 11 to 7. Said surface is more concave than in man.

The coracoid process is long and massive, and is bent downward and inward much more than in *Castor*. It is .75 of an inch long,

the same in width, and about .25 of an inch in thickness. The scapula has a well-defined neck, which has a greater diameter of 1.12 inches and a lesser of .62. A broad semicircular notch (very similar in form to that we see in *Castor*), three-fourths of an inch deep, in the anterior border of the spine, throws the acromion process nearly an inch from the adjacent border of the glenoid cavity.

The acromion, with the broader portion of the spine, presents a marked difference from the same feature in *Castor*. In the latter the spine is nearly the same thickness all along the crest, the acromion being twisted anteriorly. In *Castoroides* the acromion and spine are relatively much broader and flatter on the outer face, the former bending much more forward, and the latter narrowing much more rapidly upward and backward.

The spine, in *Castor*, stands outward from the plane of the blade, at nearly right angles; in *Castoroides*, it slants at an angle of nearly forty degrees toward the axillary border, and away from the very broad, shallow sigmoid notch. The anterior border of the blade diverges from the base line of the spine more rapidly than in *Castor*, giving a relatively wider area for the supra-spinatus muscle.

The fossa for the infra-spinatus has about the same relative depth as in *Castor*. The clavicle measures in a direct line, 4.36 inches; following the curves, 5.25 inches.

FIG. 18.—One-third natural size. Clavicles: 1, of right side, outer aspect: 2, of left side; *s*, sternal end; *a*, acromial end.

The longer diameter of the sternal enlargement is a full inch; the widest portion toward the acromial extremity is .87 of an inch. The sternal end is quite similar to what we see in *Castor*, but as we approach the middle of the bone, it is much more bent forward and downward, and thence more backward and upward, to the

acromion. The deep, roughened cavity for the attachment of the muscle which reaches from the coracoid process is a marked feature.

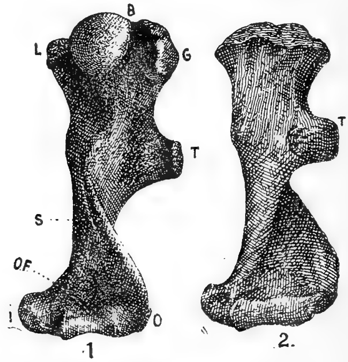

FIG. 19.—One-third natural size. 1, humerus of right side. 2, left humerus, epiphysis wanting at proximal end. *s*, Supinator ridge; *o*, outer condyle; *i*, inner condyle; *g*, greater tuberosity; *l*, lesser tuberosity; *t*, third tuberosity; *b*, bicipital groove; *of*, olecranon fossa.

In the study of the humerus the marked resemblance to its homologue in *Castor* is evident; its length, 7.36 inches; greatest breadth (across condyles), 2.25 inches; breadth at upper extremity, 2.12 inches; diameter of shaft, including deltoid ridge with its tuberosity, 1.9 inches.

Looking at the entire bone, it is flattened, and has quite a twisted appearance, seen from the outer border, owing to the broad blade of the supinator ridge. This blade extends from the outer condyle upward, forward and inward, nearly fading out about two-thirds of the way, and almost connects with a low ridge downward from the lesser tuberosity. The head is sharply defined. With the shaft in a vertical position, the head looks backward more than upward. It is very convex in all directions. The articulating surface antero-posteriorly is relatively longer than in *Castor.* Laterally and posteriorly there is a short but well-defined neck.

The greater or outer tuberosity is less prominent than the inner, but much more massive, and each is separated from the head by a well-marked groove; the outer groove, the bicipital, is wide enough to admit the last joint of a man's little finger edgewise, and the inner sufficiently to admit the same flatwise. This greater

prominence of the lesser tuberosity is the most marked difference I have been able to discover between the humerus of *Castoroides* and that of *Castor.*

The wider groove (already named) on the opposite side from the bicipital, does not reach down the front face of the shaft, but fades out on the epiphysis.

The front face of the shaft is broadly concave, laterally, nearly half way down, owing to the prominence of the deltoid ridge, and the swell at the base of the lower or third and outer tuberosity. This third tuberosity is a very marked feature, being largely developed, much bent backward, and at the extremity slightly inward. It is nearly an inch in length, following the curve, three-fourths of an inch wide, and very rough on the outside. The deltoid ridge is most prominent at base of this process, from which it rapidly descends and fades out in the direction of the trochlea. There is also a secondary inner tuberosity, very slight, nearly opposite the outer, also observable in *Castor.*

The olecranal fossa is well marked, but not deep. It is about an inch transversely, .3 of an inch vertically, and .12 of an inch deep in the center. The longer diameter is not quite at right angles with the shaft, the inner end being a little the lowest. There is a fairly well-marked fossa anteriorly, directly opposite the olecranal, and parallel with it. The internal condyle is .75 of an inch long, the same in width near the middle, very stout, slightly bent backward, and has a deep, rough fossa near the base, posteriorly. Said fossa slants under the trochlea. The articular surface, posteriorly, is .95 of an inch across, anteriorly it is 1.35 inches across, the most prominent part of the capitellum being about midway. The ulna, minus the distal epiphysis, is 8.51 inches; the full length was something over 9 inches.

The length of the olecranon, from middle of sigmoid cavity, is 1.75 inch. The area for attachment of triceps muscles is nearly an inch across. Greater diameter of shaft, two inches from sigmoid

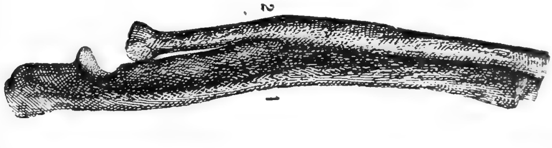

FIG. 20.—One-third natural size. Ulna (1) and radius (2). Distal epiphysis wanting.

cavity, is .9 of an inch. Diameter of smallest portion, near distal end, is .5 of an inch.

There is a strongly marked, longitudinal fossa, half an inch wide, on the outer surface, beginning below the middle of the sigmoid cavity, and reaching forward to nearly half the length of the shaft, as seen in *Castor*, and less marked in *Fiber*.

The radius, minus the epiphysis, is 6.85 inches in length. Greater diameter of the distal face, which was joined to the epiphysis, .95 of an inch. Greater diameter of the head, one inch. As in *Castor*, the radius, *in situ*, lies directly upon the upper edge of the shaft of the ulna, nearly or quite touching it all the way.

There does not appear to have been so much of an apparent approach to the fusion of the two bones as we find in a mature skeleton of *Castor*. The forearm, both bones taken together, is relatively more slender as compared with *Castor*, and rather more bent. When the forearm was extended, as far as the articulation at elbow would appear to admit, it still made an angle with the humerus of about 135 degrees. The arm, however, could completely fold on itself with ease, and that it did so abundantly would seem evident from what appears to be a well-marked, abnormal fossa, *worn* into the shaft of the humerus by the anterior border of the sigmoid cavity. Said fossa is one-fourth of an inch above the trochlea.

The remaining portions of the anterior extremities are, so far, entirely wanting.

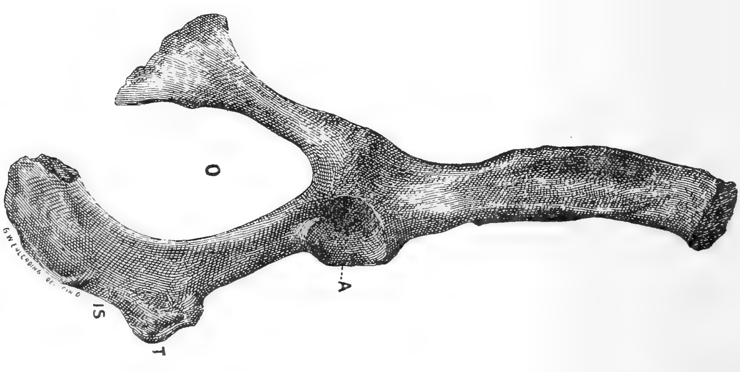

FIG. 21.—One-third natural size. Left innominata, anterior epiphysis missing; pubic region missing. *a*, Acetabulum; *t*, tuberosity of ischium; *o*, obturator foramen.

The pelvis is badly broken, but enough is left, reliably to determine the main points. The sacrum has been noticed already. The pelvis of a beaver, muskrat or ground-hog would greatly aid the ordinary reader in picturing the corresponding region of *Castoroides.*

The innominate bones in the four genera, omitting the pubic portion, consist of a pair of irregular, shaft-like pieces, whose axes are approximately parallel to each other, and to the spinal column. The posterior borders of the iliac turn downward nearly at right angles toward the symphysis pubis; giving the posterior part of the united innominata a nearly square, truncated appearance, except that in *Castoroides* this posterior region is more rounded backward. Looking through the entire pelvis from behind, we note a pretty well defined triangular cavity.

The innominate bone, in the absence of the epiphysis of the crest, which would add at least one-fourth of an inch, measures 11.75 inches; tuberosity of ischium to symphysis pubis, 5.3 inches; center of acetabulum to back part of tuberosity of ischium, nearly 4.0 inches; from same point to posterior curve of ischium, 5.8 inches; same point to anterior symphysis pubis, 4.0 inches; greater diameter of obturator foramen, 3.85 inches; lesser diameter of obturator foramen, 2.12 inches.

The form of the obturator foramen is approximately ovate, with the greater curvature above, as in *Castor.*

Each iliac shaft flares outward from about its middle to near its crest, where it suddenly projects at right angles, not so much by the outward bending of the shaft, as by the outward extension of the crest. The measurement across, from point to point of these crests, if the epiphyses were present, would not be less than from 9½ to 10 inches.

The shaft of the ilium is triangularly prismatic. The side that looks upward is broader than the side that faces downward and outward, and both are decidedly concave, not only laterally but antero-posteriorly. The portion of the inner face in front of the articular surface (for the sacrum) is concave in a crosswise direction. Said articular surface is about midway of the inner face of the ilium. The length of the symphysis pubis can not be determined, as part of the connection is missing on both sides. The acetabulum is nearly hemispherical, the border rising highest in front; antero-posteriorly it measures 1.25 inches; vertically it measures 1.2 inches; width of cotyloid notch, .5 inch.

The femur, like the humerus, is flat, but not twisted as is the latter. Its greatest length is 7.2 inches; greatest width across condyles, 2.3 inches; greatest width across tuberosities, 2.7 inches; least width across shaft, below middle, 1.2 inches; least thickness of shaft, .8 inch; length of articular surface for patella, 1.35 inches; width of articular surface for patella, 1 inch; neck, well defined, greater diameter, .8 inch; lesser diameter of neck, .5 inch.

The axis of the neck makes an angle of about 130 degrees with the axis of the shaft, and is slightly bent forward.

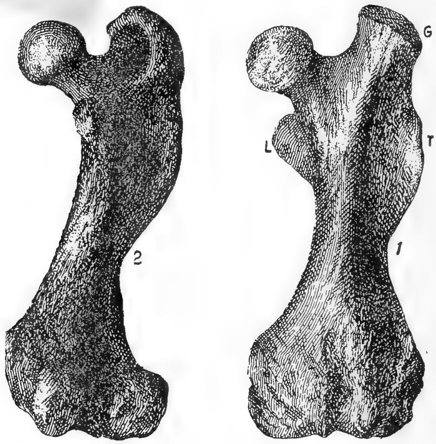

FIG. 22.—One-third natural size. Femur: 1, left side, anterior aspect; *g*, great trochanter; *l*, lesser trochanter; *t*, third trochanter. 2. Right side, posterior aspect.

The fossa between condyles is half an inch wide in front, and three-fourths of an inch behind. With the shaft in a vertical position, the great trochanter rises half an inch or more above the head, from which it is separated by a notch as wide as the width of an average finger.

Of the same dimensions is the notch separating the lesser trochanter from the head. The trochanteric fossa just buries the end of a medium-sized thumb, and has a rougher secondary depression in its middle.

In *Castor* will be noticed the well-defined third trochanter, with its greatest prominence midway of the outer border of the flattened

shaft. The homologue of this in *Castoroides* is a thick, heavy blade, a process elongated and warped forward at its outer edge, where it is thickest.

Its greatest prominence is nearly opposite the lesser trochanter, being much higher up and relatively nearer the great trochanter than in *Castor*. This blade, as it reaches further down, descends to the shaft below its middle, and is continuous with a crest that meets it from the outer tuberosity below.

In the form and position of the third trochanter, *Fiber* is intermediate between *Castor* and *Castoroides*. This femur has a massive look, and its extremities, especially, have a more or less crumpled, pitted and spinescent appearance.

The length of the tibia, between remotest points, is 9.9 inches.

The fibula, on both the right and left sides, is broken, and the lower epiphysis, including the external malleolus, is gone, but its

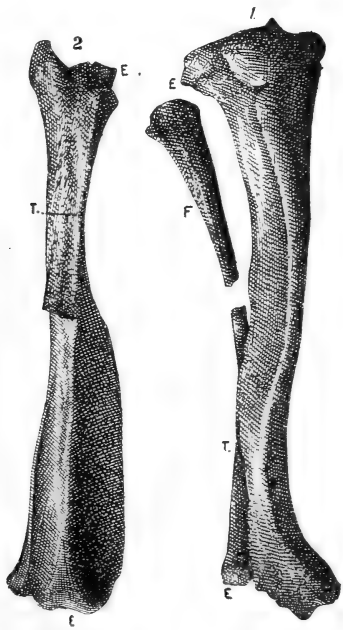

FIG. 23.—One-third natural size. Tibia and fibula: 1. right, anterior view: 2, left, posterior view, upper end down: epiphyses wanting at *e, e, e*; *f*, fibula; *t*, fibula fused with tibia.

entire length was very nearly 8.75 inches. For 3.75 inches, over one-third the length, it is so thoroughly fused with the tibia that in

places it is with difficulty that the line of union can be traced. In this respect it closely resembles *Fiber*, where the fusion is for half the length of the bones. The shaft of the tibia, above its junction with the fibula, is distinctly three-sided, and is bent so as to present a convexity, forward. For about the lower third it is so bent as to have the convexity backward, and a very decided concavity in front, owing to the greater enlargement of the lower extremity forward and inward.

Further, as to the upper portion, there is a broad convex side (broadest at the summit and narrowing downward), which looks forward and inward. This face is bounded exteriorly by the very prominent crest, which is the border of a stout blade curving outward. The outer side is broadly and deeply concave, the trough bounded anteriorly by the crest above named, and posteriorly by another blade which extends from the external tuberosity to the point where the tibia and fibula unite. The posterior, the narrowest side, is also quite concave.

The external tuberosity is very prominent, reaching outward and backward, where it is supported by the relatively broad head of the small fibula. The fibula below is proportionally smaller than in *Castor*, but proportionally larger above. The upper end was doubtless capped with the large epiphysis, with its external hooked spur as seen in allied genera. The external malleolus bears somewhat inward, so as to make a bearing with the outer articulating surface of the astragalus.

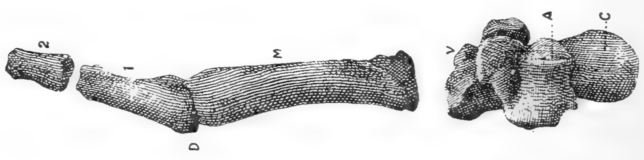

FIG. 24.—One-third natural size Parts belonging to left hind foot: *a*, astragulus, resting on (*c*) calcaneum; *v*, vacancy, absence of cuboid; *m*, fourth metatarsal; 1, 2, first and second joints of fourth digit; *d*, deformed joint.

Of the hind feet we have, on the right, the astragalus, the five metatarsals, and the first phalanx of the third digit. Of the left foot we have the astragalus, calcaneum, the I, III, IV and V metatarsals, the first phalanx of the third digit, and the first and second of the fourth digit.

In no part is the detailed correspondence of structure between

Castor and *Castoroides* more marked than in the feet. Whoever will look at a beaver's hind foot will see its fossil ally.

The astragalus has the usual pulley-like groove, obliquely, from before backward, with the shorter and more abrupt slope upward, toward the internal malleolus, and its longer and more gradual slope upward and outward. The groove is relatively a little deeper than in *Castor*. Diameter across the upper articular surface, 1.14 inches; from process to process, at base, 1.55 inches; greatest antero-posterior diameter, 1.51 inches.

The anterior articulating surface of the head, as it extends beneath and backward, is continuous with the surface, which articulates with the upper side of the internal process of the calcaneum.

The calcaneum measures, from tuberosity to antero-interior process, 3.25 inches; length of the backward projection, 1.60 inches; lateral diameter of tuberosity, 1.15 inches; vertical diameter of tuberosity, .86.

The inner projection for the support of the astragalus is relatively greater than in *Castor*, and the tuberosity is more thickened vertically.

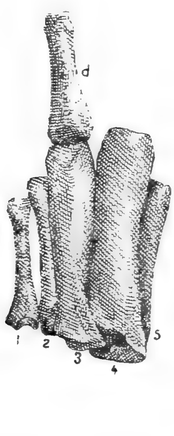

FIG. 25.—One-third natural size. Parts belonging to right hind foot: 1, 2, 3, 4, 5, metatarsals in their order from within outward: 5 sits on tubercle underneath the base of 4.

To see the metatarsals in *Castor* is to see them in *Castoroides*, with but a very slight modification to increase the scale, and a little variation as to proportionate length. The fourth metatarsal in *Castor* is the longest and stoutest, yet its pre-eminence in this

respect is not so marked as in the specimen before us. In length they measure and compare as follows:

	Castoroides.	*Castor.*
I	2.12 inches	1.16 inches.
II	2.63 "	1.62 "
III	3.38 "	2.00 "
IV	4.00 "	2.25 "
V	2.75 "	1.50 "

No. I, which supports the homologue of the "great toe," which is here the least toe, has the wide, nearly semicircular, pulley-like groove in the proximal end, which, as in *Castor*, articulated with the internal cuneiform alone.

No. II, which is comparatively slender, is much enlarged at the distal end, where it is somewhat bent inward (toward the left foot). It is much flattened laterally at the base, where it joined the small middle cuneiform. This flattened proximal end is squarely truncated, and has a shallow fossa for the articulating surface, and a tubercle on the under side.

From the markings on either side, it was evidently closely packed between the forward and outward process of the middle cuneiform on the one side, and the base of the adjoining metatarsal on the other. No. II reaches both further forward and farther backward than No. I.

No. III appears at once to be four or five times stouter than No. II. It also bends inward toward the distal end. (This inward bending helped to give spread to the toes.) The base, superiorly, is broadened and obliquely truncate from within outward and backward. The articular surface is concave, vertically. A strong, prominent tuberosity extends downward, inward and slightly backward, giving the base a twist to the inward, on the under side.

No. III must have articulated at the base only with the external cuneiform. It will be seen in *Castor* that No. III extends quite as far, if not a little farther, forward at its distal end than No. IV, while here there is quite a perceptible falling short. The backward slanting base of No. III ends in a spur which laps on to a shoulder of the adjacent point of No. IV, giving the latter a kind of secondary articular surface on the upper, inner base.

This feature is more marked than in *Castor*. The base of No. IV (the giant brother of the set) is slightly convex, slants backward toward the outer margin, and also toward the lower margin.

Its base also is twisted with the bottom inward, terminating in a powerful inferior tuberosity. Its shaft bends slightly outward from the middle toward the distal end. This bending away from each other of Nos. III and IV, is not seen in the recent beaver foot used in this comparison. No. IV projected slightly the farthest back of any in the series, bearing a shoulder against a spur of No. III, and pushing its base back, occupied the full face of the cuboid. The articular face is not so convex as in *Castor.*

No. V is but a magnified view of the corresponding member of *Castor:* a broad base exteriorly, gibbous below, with a flattened tuberosity which slants forward along the under side of the shaft into a low crest, an oblique concave articular surface, which fits to a convex condyle near the under, outer base of No. IV, the whole base and nearly half of the shaft being nearly concealed under the larger member with which it joins, so that its proximal end does not touch any metatarsal. The articular surface is three-fourths of an inch long by one-third of an inch wide. The shaft bends gently outward, through nearly half its length toward the distal end, and a very little downward.

The first phalanx of No. III was found, and also the first and second phalanges of No. IV, which is the longest and most powerful of the metatarsals.

Nos. I and V look as though they might have been nipped off and healed while the subject was still alive, and the first phalanx of No. IV appears to be deformed at its base, as if it had at some time received an injury. It is abnormally large, and the toe is bent to one side. (Was the poor fellow caught by the foot in some prehistoric trap?).

The distal ends of all the metatarsals have the articular surfaces very convex, vertically, the lower half of the face, as it bends under and backward, being double, having a very short ridge, on either side of which is a groove. By this means a strong hinge joint is produced when the toes are flexed, and a partially ball and socket joint when the same members are extended.

The proximal ends of the first series of phalanges are concave, with a sharply-defined notch in the lower border of the articular surface. These notches cover the sharp, spur-like ridges of the distal ends of the metatarsals, as already described.

The sharply-defined, well-pitted and roughened scars which mark the attachments of the various ligaments and tendons, indicate how powerfully the parts of the feet were held together.

The entire length of the hind foot was 12¼ to 12½ inches. No fragment of either fore foot was preserved.

III ZOOLOGICAL RELATIONS AND PROBABLE HABITS.

As is already well known, the zoological relations of this species have heretofore been determined almost entirely from the head, which Col. Foster thought sufficiently similar to that of *Castor* to warrant the generic name *Castoroides*, which name later authorities have not seen fit to change.

From important structural differences in the teeth, especially in the molars, the relatively small brain cavity, the extraordinary modification of the posterior nares, and from other marked differences, Prof. J. A. Allen has given it a separate family standing under the title *Castoroididæ*. A study of the osteological features so far as now developed, will probably warrant this new family name, considering the importance of some of the structural relations on which it is based. As to the double posterior nares, there is a perceptible approximation to the same in the direction and position of the internal pterygoid plates of *Arctomys*.

Had the first find consisted of molar teeth alone, comparative anatomists might have said, here is a gigantic North American *Chinchilla*. Had the head never been seen, and its classification based on the feet alone, we would simply say, a new species of *Castor*. Had a tibia and a fibula alone been found, all would probably agree that it was strikingly similar to *Fiber*. Had all except the head been found, there would have been no occasion to look outside the family *Castoridæ*.

Prof. Allen remarks in his Monograph: "It will be seen that *Castoroides* presents a singular combination of characters." That it is a generalized rodent type is all the more confirmed from a comparative study of the nearly entire skeleton. The case of anchylosis, involving the axis and the third cervical, is probably exceptional. From the very powerful incisors and their massive setting, staunchly buttressed as they are on the lingual side, together with every evidence of extraordinary muscular strength for operating the lower mandibles, does it seem probable that they (the incisors) were employed solely for cutting the food needful for sustenance?

They probably gnawed down trees. The feet afford what appears to be satisfactory evidence of having been webbed, indicating an aquatic life.

The long, stout tail, with its thick-winged, bifurcate lateral processes, though relatively much narrower than the skeleton tail of the recent beaver, was, nevertheless, pretty surely flattened in the same direction, though not to the same extent. It evidently was not cylindrical as in the rat, and it could not have been compressed, as in the muskrat.

The shoulder, elbow, hip, knee and tarsal joints not only have provision for close folding, but give evidence that they were folded at sharp angles as a habit, showing that the creature held its body low.

If it felled trees and was aquatic in its habits, would it be an inexcusably rash suggestion that there may have been colonies of them employed in dam building, and that our subject may have helped to make the pond in the silt of which he was finally buried? The silt was immediately above drift gravel.

In three cases within the writer's knowledge, fragmental or entire incisors of *Castoroides* have been found associated with Mastodon remains.

THE JOURNAL

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Vol. XIII. CINCINNATI, JANUARY, 1891. No. 4.

PROCEEDINGS.

REGULAR MEETING, *October* 7, 1890.

The Treasurer, Davis L. James, in the chair.

The minutes of the September meeting were read and approved.

Mrs. Maynard French, Thomas M. McConn, George L. Talley and David W. Miller were proposed for active membership.

Dr. J. L. Krouse, Latham Anderson and Enoch Megrue were elected to active membership.

The minutes of the Executive Board for July and August were read.

The resignation of Ketaro Shira-Yamadani was read and accepted.

Mr. J. Ralston Skinner gave a very interesting and instructive informal talk on the geological and physical features of Watch Hill, Rhode Island; on the migration of certain birds, and some observations on the fauna of that vicinity.

The list of donations was read and the Society adjourned.

REGULAR MEETING, *November* 11, 1890.

President Abert in the chair.

The minutes of the October meeting were read and approved.

Mrs. Maynard French, Thomas M. McConn, George L. Talley and David W. Miller were elected to active membership.

The minutes of the Executive Board for September were read.

The resignations of Mrs. Sophia H. Rosenbaum and Charles H. Allen, Jr., were read and accepted.

The Secretary read by title a paper "On the Genus Sphenophyllum," by Prof. J. S. Newberry; also a paper by title "Concerning a Skeleton of the Giant Fossil Beaver, *Castoroides Ohioensis*," by

Prof. Joseph Moore. The latter paper was alluded to by title at the meeting of February 4, 1890, but was not noticed on the minutes.

The President, Col. James W. Abert, gave an entertaining account of the mountainous district of Virginia, and alluded to the formation of mountains in general. His remarks on the mining operations of Maryland and Virginia were very interesting.

Mr. Charles Dury exhibited several specimens of the Leaf Butterfly of India (*Kallima inachus*), collected by William Doherty, a corresponding member of the Society.

The Society met for the first time this evening in the new auditorium in the new annex to the Society's building, and notwithstanding the very inclement evening, there was a fair attendance of members, who were much pleased with the spacious and comfortable lecture-room.

The list of donations was read and the Society adjourned.

REGULAR MEETING, *December* 2, 1890.

President Abert in the chair.

There were fifty persons present.

The minutes of the November meeting were read and approved.

Mrs. Lida Bacon, E. T. Flynn, B. W. Williamson, Dr. Charles T. Phythian and S. Marcus Fechheimer were proposed for active membership.

The minutes of the Executive Board for October were read.

The deaths of Prof. J. M. Edwards, an original and life member, and of Miss Mary C. Tatum, an active member, were announced by the Secretary.

On motion a committee, consisting of Messrs. Skinner, James and Norton, was appointed to prepare and report a tribute of respect to the memory of Prof. Edwards.

The Secretary announced that the large paleontological, mineralogical and archæological collections of Paul Mohr, Esq., would be donated to the Society provided a subscription fund of $5,000 could be raised for same.

Mr. Wm. H. Knight gave a very interesting and instructive account of the Puget Sound Region, embracing its physical features, resources and probable future.

The Society then adjourned.

NEW AND LITTLE KNOWN AMERICAN PALEOZOIC OSTRACODA.

BY E. O. ULRICH.

(Concluded from Page 137.)

LEPERDITIA FABULITES, Conrad.

Plate XI, Figs. 1 *a*—1 *d, and* 2.

Cytherina fabulites, Conrad, Proc. Acad. Nat. Sci. Phil., 1843, p. 332.

This much quoted and yet so illy known species, has been a source of much trouble to specialists in this class of fossils. My endeavors to collect a full series of specimens from localities in Wisconsin, Minnesota, Illinois, Kentucky and Tennessee, have been fairly successful, so that I am now able to point out and illustrate the really characteristic features of the species.

Plate XI, figs. 1*a*, *b*, *c* and *d*, represent four views (natural size) of a perfect example from near Beloit, Wis. The specimens from the northwestern localities are usually about one-third larger than those from Kentucky and Tennessee, but in all other respects they are practically identical. The shape, aside from peculiarities due to distortion, is very constant, the outer surface smooth or very faintly pitted under the glass. When in good condition, the outer surface exhibits not even a trace of the anterior tubercle and muscle spot which are such common features in this genus, but only a little weathering is required to disclose the suboval reticulated spot. The reticulation is in relief, from which it appears that the spaces enclosed by the meshes are composed of material giving way to the action of the weather with disproportionate rapidity. On the inner side, however, both the tubercle and muscle spot are clearly distinguishable, the former being represented here by a small but well-marked depression. (See fig. 2.) The muscle spot is surrounded by fine reticulating radial lines, short dorsally, longest postero-ventrally.

Perhaps the most characteristic feature of the species is found in the small papillæ which occur on the inner side of the ventral mar-

gin of the right valve, four in the posterior third, and three or four in the anterior third. On the outer side of the test these are generally represented by an equal number of small pits. The purpose of these two sets of papillæ seems to have been to prevent undue overlapping of the valves, by presenting an obstacle to the entering ventral edge of the left valve.

Such pits at the ventral edge of the right or overlapping valve, (and I think we may safely assume that they always represent internal papillæ,) are known to me in at least three other species, *L. linneyi* and *L. tumidula*, the two next described, and *L. bivia*, White.* In the first of these there are two in the anterior half and one or two in the posterior, but in the other two species only one occurs on each side.

It is possible that the Canadian species *L. josephana*, Jones, is the same as *L. fabulites*, but as that species often, if not always, exhibits an anterior tubercle on the *outer* side of the carapace, and since no pits nor papillæ have as yet been detected on the ventral margin, it is reasonable to suppose that Prof. Jones' species may prove distinct.

Position and locality: In Tennessee the species is very abundant in Safford's "Glade limestone" at Lebanon, Lavergne and other localities. This limestone I regard as equivalent to the Birdseye of New York. The species occurs also in the "Central limestone" near Murfreesboro. In Kentucky, silicified valves are sometimes very abundant near the top of the Birdseye at High Bridge. At Dixon, Ill., Beloit, Wis., Minneapolis, Minn., and other localities in the northwest, the species is a characteristic fossil of the lower portion of the series of limestones resting on the St. Peters sandstone. This horizon I regard as equivalent to the "Glade" of Tennessee, and the Birdseye of Kentucky and New York.

LEPERDITIA LINNEYI, n. sp.

Plate XI, Figs. 3 a—3e.

Size:	Right valve:	Length,	10.45 mm.;	height,	6.9 mm.:	thickness,	2.25 mm.
	Left "	"	8.55 "	"	5.7 "	"	2.5 "
	" "	"	7.8 "	"	4.95 "	"	1.8 "

Carapace of medium size, oblique, produced and widest posteriorly; ventral edge rather strongly arched, rounding neatly into the anterior margin. Cardinal line straight, both the extremities

*The two supposed perforations at the ventral edge of the same valve of the Russian *L. grandis*, Schrenk, are doubtlessly of the same nature.

produced into sharp points. A small tubercle in the antero-dorsal region; between it and the center of each valve a large ovate spot is distinguishable in most specimens. The lower half of this spot marks the point of greatest convexity of each valve. The two ends with a well-defined flange. Right valve with the ventral edge thick and abruptly bent inward; two rather widely separated small pits situated close to the antero-ventral edge; one or two of these pits also behind the ventral overlap. Left valve more convex than the right, and less abruptly deflected at the ventral edge; a well-marked thickening along the posterior half of the dorsal margin. In both valves, but in the left especially, the slope from the point of greatest convexity toward the margins is somewhat flattened. Surface impunctate, polished; color dark brown.

The thickening along the posterior half of the dorsal edge of the left valve, allies this species to a group consisting of *L. gibbera*, and *scalaris*, Jones, *L. tyraica*, Schmidt, and one or two others. The *L. appressa* of this paper likewise belongs to this group, as may *L. tumidula* also. *L. linneyi* differs from the three first named in the outline, and in having the surface of the valves less uniformly convex.

Named for the late W. M. Linney, who was the first to bring the species to my notice.

Position and locality: Not uncommon in heavy bedded gray limestone belonging to the uppermost division of the Trenton limestone, near Harrodsburg, Perryville, Danville, Frankfort and other localities in central Kentucky. The horizon is above the *Brachiospongia* bed.

LEPERDITIA TUMIDULA, n. sp.

Plate XI, Figs. 4 *a*, *b*, *c*.

Size: { Length, 9.0 mm.; length of hinge line, 6.5 mm.; height, 6.0 mm.; thickness (a right valve), 2.3 mm.

Carapace of medium size, obliquely subovate, widest and moderately produced posteriorly; ventral curve strong, most pronounced in the posterior half; dorsal margin comparatively long, straight; the extremities simply angular, not produced beyond the curve of the ends. Ventral edge of right valve very thick, flattened, abruptly curved inward, the overlapping portion produced lip-like beyond the line of contact between the ends of the valves; one small pit on each side. Flange moderate. Valve tumid in the

ventral half, with point of greatest convexity very near the center; surface sloping rapidly from this point to the ends; cardinal slope flattened, triangular. Tubercle small, but distinct. Left valve represented by only one small individual. In this the surface is moderately convex and a little the most convex in the lower half. A faint swelling is noticeable along the posterior half of the dorsal edge. Surface smooth, apparently impunctate; specimens silicified.

This species differs from the preceding in a being a little less oblique, in having the ventral region of the right valve more tumid, the extremities of the hinge line simply angular instead of produced spine-like, and in having only one pit on each side of the ventral overlap. The triangular shape and flattened appearance of the cardinal slope is also diagnostic. *L. bivia*, White, is closely related, but differs in the outline.

Position and locality: Siliceous limestones occurring near the top of the Trenton, at Danville, Ky. The species is rather rare, only six examples having been found.

LEPERDITIA APPRESSA, n. sp.

Plate XI, Figs. 5 *a, b, c, d.*

This species is closely related to the two preceding, and as its characters are shown very well in the illustrations, a detailed description is scarcely necessary. It differs from both *L. linneyi* and *L. tumidula* in being considerably shorter, rounder, less oblique, and much less tumid. There is a well-defined swelling along the dorsal edge as in *L. linneyi.* The flange, though all the examples seen are larger, is narrower than in either of those species.

Size:	Left valve;	length, 13.8 mm.;	height, 9.8 mm.;	thickness, 2.5 mm.
	" "	" 11.8 "	" 7.8 "	" 2.0 "

Position and locality: Near top of Trenton limestone, at Danville and Harrodsburg, Ky.

LEPERDITIA CÆCIGENA, S. A. Miller.

Plate XI, Figs. 6 *a, b, c, d.*

Leperditia cæcigena, S. A. Miller, Jour. Cin. Soc. Nat. Hist., Vol. IV, p. 262, pl. VI, figs. 5, 5*a*.

The original illustrations of this species being rather unsatisfactory, I take this opportunity to offer more reliable figures of two

examples having the typical shape. Figs. *6b, c, d*, represent three views of a complete carapace of the average size. As usual this specimen shows not even a trace of either the eye tubercle or muscle spot. It shows clearly that the right valve overlaps the left all around the free margins, and that there is no flange at the margin of the left valve, and only a very inconspicuous one at the ends of the right. Fig. *6a* is the largest right valve seen. In this a very faint tubercle may be noticed.

This species is restricted to the uppermost layers of the Cincinnati group, and is exceedingly abundant at several localities. The best specimens seen I collected in Indian Kentuck creek, seven miles above Madison, Ind.

Variety FRANKFORTENSIS, n. var.

Under this name I propose to distinguish a form that is abundant in the gastropoda bed at the top of the Trenton at Reservoir Hill, Frankfort, and other localities in central Kentucky. In size and general appearance the variety is identical with the typical Indiana examples of *L. cæcigena*, but slight differences in the shape and in other respects, but more especially the fact that the form will be found of use in identifying this important horizon, induce me to distinguish it as above. A careful comparison with the typical form of the species (see Pl. XI, figs. *6a–6d*) shows that the variety has the dorsal angles sharper, an appreciably flattened border or flange at the ends of *both* valves, and the ventral edge a trifle more convex. The eye tubercle, and not infrequently the reticulated spot as well, is, though always very small, generally distinguishable. The outline is intermediate between figs. 5*a* and 6*a* of plate XI.

ISOCHILINA SUBNODOSA, n. sp.

Plate XI, Figs. 7 a, b, c.

Size: Length, 8.0 mm.; height, 4.7 mm; thickness (left valve only), 1.7 mm. A very large but imperfect right valve has a length of 13.5 mm.

Carapace oblong, subelliptical; ends subequal, rather narrowly rounded, most prominent about in the middle of the height. Dorsal margin straight, at least two-thirds as long as greatest length of valve; extremities sub-angular. Flattened border very wide but not sharply defined at the posterior end, about half as wide

and much better defined at the anterior end; very narrow at the ventral edge. Valves rather tumid at and below the center; anterior and ventral slopes abrupt, the posterior slope more gentle. Central portion of dorsal slope a little depressed, with a broad and low swelling on each side. The latter with a small tubercle near the center of the dorsal edge and a pair of similar ones situated near the antero-dorsal angle, have suggested the name *subnodosa*. Surface finely pitted.

This species is more elongate, has a wider, though illy defined, flattened posterior border, and more uneven surface than any other species of the genus known to me.

Position and locality: Upper Trenton limestone, associated with *Leperditia linneyi*, at Perryville, Ky.

ISOCHILINA SAFFORDI, n. sp.

Plate XI, Figs. 10 *a, b, c, d.*

Size: { Small right valve; length, 5.0 mm.; height, 3.2 mm.
Large left valve; " 16.2 " " 9.6 " thickness, 4.0 mm.

Carapace large, oblong, elliptical, with the ends subequal, semicircular; dorsal margin straight or slightly convex, curving neatly into the posterior edge, but anteriorly terminating with a short spine-like prolongation. Flange sharply defined, wide at the ends (the most so at the posterior) and very narrow at the ventral side. Body of valve with point of greatest convexity in front of and somewhat beneath the center; from here the slope of the surface is flattened to the beginning of the flange where the descent is rather abrupt. Muscle spot distinguishable, situated just above the point of greatest convexity. Eye tubercle distinct. Surface with faint reticulating granulose lines.

This species is related more or less closely to a number of forms —chiefly European; but is distinguished by the peculiar surface ornamentation, the rounded character of the postero-dorsal edge, and other less obvious features.

The specific name is given as a small compliment to Prof. J. M. Safford, the State geologist of Tennessee, who, in his work on the geology of that State, did not overlook even this so generally neglected class of fossils.

Position and locality: Upper Trenton limestone, Nashville, Tenn. The specimens are a glossy black, and occur in a compact, dark gray limestone.

ISOCHILINA AMPLA, n. sp.

Plate XI, Figs. 8 *a, b, c, d.*

Size: { Length, 17.8 mm.; height, 13.0 mm.; thickness of one valve, 6.0 mm.
" 21.4 " " 17.0 "

Carapace large, oblique, widest posteriorly, unusually high, and strongly convex, with point of greatest convexity very near the center. Dorsal edge straight, long, obtusely angular behind, pointed in front. Flange distinct, narrow in front, wanting at the ventral edge, and of moderate width behind. Ventral region tumid, descending abruptly to the edge. Dorsal slope very abrupt. Eye tubercle distinct but rather small. Just behind it a slight depression, and beneath the latter the oval reticulated spot. (Not shown in fig. 8*a*.) Surface polished, apparently without punctæ or ornament of any kind. Internal characters as shown in fig. 8*d*.

This fine species is larger, higher and fuller than any other so far known from American rocks. *I. jonesi*, Wetherby, which is perhaps more nearly related than any of the others, differs principally in being less high, and in the outline of the ventral edge.

Position and locality: Upper beds of the Trenton limestone at Nashville, Tenn.

ISOCHILINA JONESI, Wetherby.

Plate XI, Figs. 9 *a, b, c.*

Isochilina jonesi, Wetherby, Jour. Cin. Soc. Nat. Hist., Vol. IV, p. 80, 1881.

This species, of which the above cited illustrations represent the largest example seen, is very abundant in the massive gray limestone forming the top of the Trenton near Harrodsburg, Ky. The same bed contains *Leperditia linneyi*, *L. appressa*, and other Ostracoda. The specimen figured is perhaps a very little higher than usual, but the difference is so small that we may with propriety regard it as a typical example of the species.

ISOCHILINA KENTUCKYENSIS, n. sp.

Plate XI, Figs. 11 *a, b, c, d.*

Compare *Leperditia* (*Isochilina*) *armata*, Walcott, 35th Rep. N. Y. St. Mus. Nat. Hist., p. 213, 1883.

Size of left valve: Length, 4.9 mm.; height, 2.66 mm.; thickness, 0.83 mm.

The outline of the specimens for which the above name is proposed agrees very nearly with that of *I. armata*, Walcott, the chief differences being that in that species *both* extremities of the long hinge-line are produced into short spines, while in this only the anterior end is prolonged; in Walcott's species the ventral margin is less convex and therefore more nearly parallel with the back, and the two ends more narrowly rounded in the lower half. The eye tubercle in *I. Kentuckyensis* is smaller and farther removed from the antero-dorsal angle, while the ventral tubercle or spine is much smaller, directed backward, and does not project beyond the ventral edge. The valves are also less and more evenly convex, there being no pronounced swelling above the spine. A row of minute pits along the ventral edge, and a narrow flange all around the free margins, two features not noticed in *I. armata*, aid in separating the species.

I. Kentuckyensis should be compared also with Kalmodin's *Leperditia tuberculata*, Œfvers, K. Vet.-Akad. Förh. (1879) 1880, which also has a sharp ventral spine.

Position and locality: In the Birdseye limestone, upper beds, at several localities in Mercer county, Ky., and at Frankfort, Ky.

ISOCHILINA AMIANA, n. sp.

Plate XI, Figs. 12 *a, b, c.*

Size of rather large right valve: Length, 5.1 mm.; height, 3.0 mm.; thickness, 1.13 mm.

Valves rather small, obliquely ovate, produced and widest posteriorly; ventral edge moderately convex, rounding neatly into the anterior margin; back straight, rather short, obtusely angular at the extremities. Posterior edge most curved in the lower half. Antero-dorsal region generally somewhat elevated, with a V-shaped or illy defined depression just behind the elevation. In a few specimens two faintly marked tubercles on each side of the depression add much to its definition. In others over half of the dorsal slope back of the anterior swelling may appear depressed. Central portion of valves strongly convex. Flange narrow, smooth, usually of nearly uniform width and extending all around the free margins; rarely obsolete at the anterior end. Surface impunctate, occasionally exhibiting a few obscure radiating lines over the central portion of the valves.

Variety INSIGNIS, n. var.

Plate XI, Fig. 13.

Associated with hundreds of the typical form of this species, as described above, I find two specimens differing from the usual forms in one respect only. Namely, in having a transverse ridge or crest-like elevation a little in front of the center of the valves. This feature causes the variety to resemble *I. cristata*, Whitfield sp., but the shape of the valves of that species is different, they being shorter with the posterior margin more oblique.

I. ottawa, Jones, has the ends more equal, the extremities of the hinge distinctly angular, and is without the depression in the dorsal slope. *I. gracilis*, Jones, likewise has the dorsal angles sharper, and the posterior end more truncate. Both of these species have a row of minute pits along the ventral edge, a feature not noticed in *I. amiana*.*

Position and locality: This species is very abundant on the bed-planes of an erratic block of limestone, found by Mr. H. M. Ami, of the Geological survey of Canada, in Sussex street, Ottawa, and supposed to belong to an upper member of the Chazy group. Part of this block was kindly given to me by Mr. Ami.

PART II.

UPPER SILURIAN AND DEVONIAN SPECIES.

LEPERDITIA (?) SUBROTUNDA, n. sp.

Plate XVI, Figs. 1 *a, b, c.*

Size of left valve: Length, 0.85 mm.; height, 0.68 mm.; thickness, 0.21 mm.

Carapace small, short, rounded, uniformly convex, encircled, except at the strongly convex ventral edge, by a flattened border, widest in the postero-dorsal region. Dorsal edge scarcely straight,

* Since the above was written I have received from Prof. T. Rupert Jones proofs of two plates which have been prepared for the Geological Survey of Canada. On plate X I notice figs. 10*a* and 11*a* because I am satisfied that they have been drawn from specimens of *I. amiana*. These figures are marked "*I. ottawa*, variety," but, for the reasons stated above, I cannot accept this designation for my specimens.

gently curving into the ends. Ventral overlap distinct. Surface smooth and even, without eye tubercle or muscle spot.

The development of a flange at the dorsal border is a very unusual feature in this genus. *L. sinuata*, Hall, has nearly the same shape, but is without a flange, and, so far as known, its valves do not overlap at the ventral margin. I am inclined to believe that species of this character ought to be arranged with *Aparchites* rather than *Leperditia*.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio. Rare.

ISOCHILINA RECTANGULARIS, n. sp.

Plate XVI, Figs. 2 a, b, c.

Size of left valve: Length, 1.22 mm.; height, 0.81 mm.; thickness, 0.21 mm.

Carapace small, nearly symmetrical, with the straight hinge-line nearly as long as the valves, the upper fourth of the anterior edge a little oblique; below this the free margins to the posterior cardinal angle form a semi-circle. Upper half of posterior margin forming nearly a right angle with the hinge-line. This feature has suggested the name. A well-defined though rather narrow flange encircles the entire valve. Valves moderately convex, with point of greatest convexity in the posterior half. Eye tubercle not developed.

There are several species of *Leperditia* known that resemble this, but as ours is clearly an *Isochilina*, as that genus is now understood, there is little likelihood of confusion between them. I know of no Devonian species with which it could be confounded.

Position and locality: Same as the preceding.

APARCHITES INORNATUS, n. sp.

Plate XVI, Figs. 3 a, 3 b.

Size of left valve: Length, 0.8 mm.; height, 0.5 mm.; thickness, 0.2 mm.

This species is closely related to the Silurian *A. unicornis* (*Leperditia unicornis*, Ulrich). Prof. Jones places that species with *Primitia*, while to me *Aparchites* appears as the genus that should receive it and other forms of like character. In the present species

the valves are small, rather convex, irregular or subpentagonal in outline, with the ends subequal, narrowly rounded and most prominent in the lower half, the ventral edge straightened on each side of the protruding center, and the back straight, rather short, and without cardinal angles. An undefined and scarcely perceptible depression occasionally in the dorsal slope. Surface most elevated near the posterior margin, with the slope to this edge concave, the central portion of the valves depressed convex, and the slope to the anterior, dorsal, and ventral margins abrupt.

The posterior elevation I regard as representing the posterior spine of *A. unicornis*. This, together with the subpentagonal outline of the valves, will serve in distinguishing the species.

Position and locality: Same as the preceding.

ENTOMIS WALDRONENSIS, n. sp.

Plate XII, Figs. 3 *a*, 3 *b*.

Size of right valve: Length, 10.6 mm.; height, 6.7 mm.; thickness, 2.6 mm.

Valves oblong, subelliptical, moderately convex, back straight but short, ends subequal, the posterior strongly curved, the anterior subangular in the upper half; ventral edge moderately convex. Sulcus deep, subcentral, nearly vertical, extending from the dorsal margin more than two-thirds across the valve. A small tubercle to one side of the sulcus. No flattened border. Surface smooth.

This species is much larger than *E. madisonensis*, described in Part I of this paper. The sulcus is also less curved, and the two halves of the valves are not unequally convex as in that species.

Position and locality: Shales of the Niagara group, near Waldron, Ind.

ÆCHMINA ABNORMIS, n. sp.

Plate XII, Figs. 7 *a*, 7 *b*.

Size: Length, 1.53 mm.; height, 0.95 mm.

Valves ovate, with the anterior end a little narrower than the posterior, the dorsal edge straight and subangular at the extremities, the ventral margin rather strongly convex. A large lobe slightly overhangs the posterior margin; another is situated just within the anterior half of the ventral margin. Spine strong,

pointing mainly upwards and a little forward; it arises from the dorsal slope a little behind the center of the length of valve.

This species is associated with *Æ. spinosa*, Hall sp., but is generally larger, and less symmetrical, while the two marginal lobes impart an abnormal appearance to the valves that is quite foreign to that species.

Position and locality: Shales of the Niagara group, at Lockport, N. Y.

ÆCHMINA MARGINATA, n. sp.

Plate XVI, Fig. 5.

Size: Length, 0.6 mm.; height, 0.31 mm.; length of spine, 0.75 mm.

Valves small, elongate, narrowest anteriorly, with the dorsal edge straight and long, the angles obtuse, and the free margins forming nearly a semicircle. A slightly elevated marginal rim. Spine very long and slender. The marginal rim allies the species to *Æ. spinosa*, but the valves are more elongate and the spine much longer. In both of these features the species approaches the Wenlock *Æ. cuspidata*, Jones, but that form is without a marginal rim, and has the base of the spine stronger.

Formation and locality: Shales of the Hamilton group, 18-mile creek, N. Y.

HALLIELLA, n. gen.*

Valves similar to *Primitia*, but with a larger sulcus, narrow at the dorsal edge, and widening as it extends downward. Posterior lobe smaller than the anterior; the latter generally divided at or near the straight dorsal edge. Surface of lobes coarsely sculptured, or reticulate, perhaps also smooth, ventral edge thick, generally with a "frill" or a rim-like projection over the contact edges of the valves.

In the present state of our knowledge it is exceedingly difficult to draw up a satisfactory description of this genus. I am convinced, however, that the species for whose reception this new genus is proposed are not *Primitia* any more than are those for

*Named after Dr. James Hall, of Albany, N. Y. He requires no introduction.

which *Beyrichiella*, Jones and Kirkby, has been established, and I do not doubt that with more material and the new forms that are being continually brought to light, the present difficulty of picking out the really diagnostic characters will gradually be overcome.

Provisionally, I propose to place two species as *Halliella*, one described in Part I of this paper (p. 136, pl. VIII, fig. 6) as *Primitia* (?) *sculptilis*, the second the form next to be described. Of other species I would suggest that *Primitia seminulum*, Jones and Holl, may belong here. Perhaps also *Bollia* (?) *auricularis*, J., of which Prof. Jones writes in a letter to me, "it is not a good *Bollia*. Your *P. sculptiles* is nearer to it than any other known to me."

As to the relations of *Halliella*, I should say in the first place that they are with *Primitia* on the one hand and *Ctenobolbina* on the other, differing from the latter in this, that the posterior lobe is not bulbous.

HALLIELLA RETIFERA, n. sp.

Plate XV, Figs. 5 *a, b, c, d, e.*

Size: { Right valve; length, 1.38 mm.; height, 0.95 mm.; thickness, 0.5.
Left valve; " 1.42 " " 0.97 " " 0.52.

Valves slightly oblique, short, subovate, hinge-line straight, cardinal angles obtuse; ends slightly unequal, the anterior most prominent in the upper half, the posterior in the lower. A depressed, concave, smooth marginal rim, widest in the postero-dorsal region. Sulcus oblique, sharply impressed, situated behind the center, extending from the dorsal edge about one-third across the valve. Surface rising gradually in passing around the sulcus from the narrow upper portion of the posterior lobe to the point of greatest convexity in the anterior half of the valves. The broad dorsal end of the ventricose anterior lobe often divided by a faint mesial impression. Surface of lobes rather coarsely reticulated. Contact edges of valves bevelled; hinge thick, apparently with a small anterior tooth. (See fig. 5*e*.)

Several reticulated species are associated with this, but as they are all quite distinct in other respects, they are not likely to be confounded.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA PUNCTATA, n. sp.

Plate XII, Figs. 5 *a, b, c.*

Size of right valve: Length, 1.5 mm.; height, 1.0 mm.; thickness, 0.3 mm.

Carapace moderately convex, subovate, with the ends nearly equal, the anterior one very slightly the narrowest, the back straight, rather long, the dorsal angles about 110°; outline of ventral two-thirds semicircular. Flange or frill of moderate width, best developed at the ventral edge, becoming obsolete gradually before reaching the dorsal angles. Posterior sulcus deep, sharply defined, nearly vertical, slightly curved. Anterior sulcus wanting, but there is an oblique swelling, forming the most prominent portion of the valves, in the anterior half. Posterior lobe large, but of more ovate shape than in the typical Cincinnati species. Surface punctate.

This is an unquestionable *Ctenobolbina*, with relations to *C. ciliata* var. *emaciata*, (ante p. 109; p. 8 of reprint), but distinguished from that and all the other species known by its punctate surface. Comparison with the figures on plate VII, will reveal other differences.

Position and locality: Shales of the Niagara group, Lockport, N. Y.

CTENOBOLBINA PAPILLOSA, n. sp.

Plate XV, Figs. 8 *a, b, c.*

Size of left valve: Length with frill, 1.43 mm.; height with frill, 0.87 mm.; thickness, 0.4 mm.; length without frill, 1.32 mm.; height, 0.76 mm.

The valves of this species have the shape generally met with in *Ctenobolbina.* Lobation bijugate. The posterior sulcus, though well marked and deep, is comparatively short, causing the posterior lobe to be less distinct than usual. Central lobe large, prominent; anterior sulcus narrow but well-impressed, vertical, like the posterior sulcus extending but little more than half across the valve; anterior lobe small. Frill or flange well-developed. Surface strongly papillose, with the papillæ largest on the lobes.

This well-marked form is distinguished from the Silurian species

of the genus by the shorter and more erect character of the sulci, and more strongly papillose surface.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA INFORMIS, n. sp.

Plate XV, Figs. 6 *a, b, c.*

Size of right valve: With frill; length, 1.51 mm.; height, 0.92 mm.; thickness, 0.35 mm.; without frill, length, 1.4 mm.; height, 0.85 mm.

Valves subovate, back straight, ends strongly convex, the anterior the narrowest; ventral edge convex, rounding uniformly into the ends; dorsal angles obtuse. Sulcus deep and very wide, extending a little more than half across the valves. Posterior and median lobes united, U-shaped, thick at the bend, with three undefined swellings, one forming the major part of the posterior lobe, the second at the antero-ventral portion of the bend, while the third, comprising the upper half of the median lobe, projects slightly beyond the dorsal edge. Anterior lobe wanting, this portion of the valve being evenly convex. Frill bent inwards, scarcely distinguishable in a side view, concave on the inner side and forming a channel around the contact margin of the valve. Surface smooth.

This rudely marked species, though deviating in several important respects from the typical species of the genus, still retains, I believe, the more essential characters of *Ctenobolbina*. An approach toward *Bollia* is recognizable, particularly to such a form as *B.* (*?*) *auricularis*, Jones, but that species is not a good *Bollia*, and, as I view it, would be more fittingly disposed of under *Ctenobolbina*. I hesitate, however, to propose such an arrangement, because the relationship to my proposed genus *Halliella* is perhaps even more intimate.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA (? BOLLIA) ANTESPINOSA, n. sp.

Plate XV, Figs. 9 *a, b, c.*

Size of left valve: Length without frill, 1.9 mm.; height, 0.9 mm.; thickness, 0.4 mm.; height with frill, 1.0 mm.

Valves elongate-ovate, widest posteriorly, ends boldly curved,

ventral margin gently convex, most prominent in the posterior half. Marginal frill wide, but frail and easily broken away, geniculated in cross-section; within it a deep channel. Anterior lobe small, isolated, vertically elongate, papillose, situated near the anterior margin. The latter with a row of small spines. Mesial and posterior lobes connected, together forming a slightly oblique loop; the former terminating at the dorsal edge in a large, papillose, and greatly elevated knob; posterior lobe well-defined, consisting of three divisions, rising step-like over each other, the highest part, an upward extension of the ventral prolongation of the mesial lobe, forming the posterior border of the deep sulcus.

In some respects the departure from typical *Ctenobolbina*, mentioned under the preceding species, is even more apparent in this. Such species as *Bollia granifera* (see pl. XII, figs. 2 *a*) must be related rather closely, and it may have been better to refer this species to *Bollia* also.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA MINIMA, n. sp.

Plate XV, Fig. 7.

Size of right valve: Length, 0.4 mm.; height, 0.26 mm.

I propose the above name for a small Primitia-like species from the Hamilton shales, at 18 mile creek, near Buffalo, N. Y. I place it under this genus chiefly because of the strong, oblique sulcus, and the general resemblance which it presents to *C. bispinosa* (see pl. VII, fig. 6) which I am confident is congeneric with *C. alata* and *C. ciliata.* The Hamilton form has a narrow flange, and has the ventral spine situated far behind, while the dorsal spine is wanting, unless a minute tubercle on the posterior side of the sulcus represents it. Surface smooth, moderately convex.

BOLLIA UNGULA, Jones.

Plate XIV, Figs. 6 a, b.

Bollia ungula, Jones, (Claypole MS.) American Geologist, Dec. 1889, p. 338, figs. 10–13.

Size: Length, 1.2 mm.; height, 0.77 mm.

The specimens of this species from the Devonian Bryozoa bed at the Falls of the Ohio, agree very closely with Prof. Jones' figures,

especially fig. 10. The duplication of the marginal rim shown in his figs. 12 and 13 is not noticed in the Falls specimens, and the bent ridge is somewhat thicker in the latter. The last difference is explained by the fact that the Pennsylvania specimens occur as "casts in buff-colored, non-calcareous shales from the Marcellus limestone," while the Falls specimens are perfect valves.

BOLLIA OBESA, n. sp.

Plate XIV, Figs. 5 *a, b, c.*

Size of valve: Length, 1.52 mm.; height, 0.98 mm.; thickness, 0.5 mm.

Carapace sub-pentagonal, ends nearly equal, strongly curved, back straight, short, dorsal angles obtuse, ventral edge produced in the middle. Marginal portion of valves thick, causing them to appear unusually ventricose. Horse-shoe ridge unsymmetrical, with bulbous extremities, the anterior knob oval, and reaching the dorsal edge, the posterior one larger, more nearly round, and terminating a short distance within the dorsal margin.

This species is not likely to be mistaken for any other known to me. Though clearly a true *Bollia*, it is very different in its general appearance from the associated *B. ungula*, Jones.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BEYRICHIA TRICOLLINA, n. sp.

Plate XII, Fig. 6.

Size of left valve: Length, 1.85 mm.; height with frill, 1.25 mm.; height without frill, 1.0 mm.

Valves sub-oblong, semi-ovate, moderately convex, with a long straight hinge line, and a very wide marginal frill. Without the frill the shape of the valves might be called nearly semi-circular, were it not for a slight prominence in the postero-ventral portion of the curve. Surface exhibiting three rounded tubercles, one near the postero-cardinal angle, another, perhaps twice as large, near the center of the dorsal margin, the third, smaller than either, situated between and a little beneath them. Besides these two, slight swellings of the surface may be noticed in the postero-ven-

tral fourth of the valves. A moderate depression of the surface occurs between and extends some distance beneath the largest and smallest of the tubercles.

The wide frill and the arrangement of the three rounded tubercles sufficiently distinguish this fine species.

Position and locality: Shales of the Hamilton group, 18 mile creek, N. Y.

BEYRICHIA LYONI, n. sp.

Plate XIV, Figs. 2 *a, b, c, and* 3.

Size: { Right valve; length, 1.58 mm.; height, 1.1 mm.; thickness, 0.5 mm.
Left " " 1.77 " " 1.2 "

Valves subquadrate, hinge line straight, anterior cardinal angle about 90°, posterior angle 110°; posterior and ventral margins slightly convex. Frill of moderate width, extending around the free margins, frail and easily broken, the posterior portion sometimes with radial ribs. Surface coarsely reticulate, normally with three elevations; (1) a low marginal ridge running parallel with the ventral edge; (2) a large, prominent, vertical tubercle, extending from the ventral ridge to and often projecting beyond the dorsal edge; (3) a much smaller, circular tubercle. A well-marked sulcus-like depression between tubercles two and three is situated very near the center of the valves.

The specimen represented by fig. 3 (pl. XIV) has the ventral lobe hypertrophied—at any rate, I have so interpreted the pronounced oval swelling occurring at the ventral edge.

The species is named after Mr. Victor Lyon, of Jeffersonville, Ind., who has carried on extensive washings of the decomposed chert layers at the Falls of the Ohio. This and other species were found in a small parcel of the residue which he kindly gave me.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BEYRICHIA (? DEPRANELLA) KALMODINI, Jones.

Plate XIV, Figs. 1 *a, b, c.*

Beyrichia Kalmodini, Jones, Quart. Jour. Geol. Soc., Nov. 1890, p. 538, pl. xx, fig. 6.

Size: { Fig. 1*a*. With frill; length, 1.58 mm.; height, 1.02.
Fig. 1*c*. " " " 1.56 " " 1.01.
" " Without " " 1.50 " " 0.82.

I am satisfied that Prof. Jones' figure represents an imperfect example of the species here illustrated. As it is one of the commonest in the "Bryozoa bed" at the falls (the locality is in Clarke Co., Indiana) it might be expected to occur in the material sent to Prof. Jones from that locality. Comparing the figures it will be noticed that his specimen (a left valve) had a very narrow anterior end, with a slight concavity in the antero-ventral portion of the margin. The character of the marginal frill does not appear to have been recognized, though I have no doubt it is preserved in the posterior half of his specimen. As the frill bends inward at its edge, it might very easily be mistaken for the contact margin (*i. e.* in specimens attached to foreign bodies or to the matrix). My figures represent internal and external views of two average right valves of the species. In neither of these is the small central node connected with the curved marginal ridge by a "narrow neck." Indeed, that condition is rare, and was not observed by me till I had seen Prof. Jones' figure, when a re-examination revealed its presence in one out of every eight or ten specimens. The form of the long sub-marginal ridge suggests an alliance with the Lower Silurian species which I have called *Depranella*. (See plate 8.)

Position and locality: Devonian Bryozoa bed, (? Hamilton group,) Falls of the Ohio.

MOOREA BICORNUTA, n. sp.

Plate XVI, Figs. 4 *a, b, c.*

Size: Length, 1.02 mm.; height, 0.6 mm.; thickness (of one valve), 0.25 mm.

Valves suboblong, elliptical, rather strongly convex, with strongly rounded, nearly equal ends, the back straight in the middle two-fourths of the length; and the ventral edge gently convex. Near the anterior margin two conical prominences or blunt spines; at the opposite end of valve a prominent crescentic ridge curving parallel with the posterior margin. Margins of valves simple, without flattened borders.

Closely related to *M. kirkbyi*, lately described by Prof. Jones (Quart. Jour. Geol. Soc., Nov. 1890, p. 542) from the Corniferous chest of New York. That species has a longer and straighter

back, with submarginal ridges at both ends. In this species we have two blunt spines, instead of a ridge, at the anterior end.

Position and locality: Hamilton group, 18 mile creek, N. Y.

KIRKBYA SUBQUADRATA, n. sp.

Plate XV, Figs, 1 *a, b, c.*

Size: Length, 0.87 mm.; height, posterior, 0.62 mm., anterior, 0.57 mm.; thickness of one valve, 0.18 mm.

Valves compressed, subquadrate, ends subequal, the anterior the narrowest and most curved; back slightly concave, ventral edge straightened, dorsal angles blunt, antero-and postero-ventral regions abruptly curved. Free margins with a sharply elevated ridge, enclosing the reticulated body of the valve. A sharply defined, large umbilical pit just in front of the center of the reticulated area. Point of greatest convexity a little behind the pit.

This, like the next two species, is related to *K. permiana*, Jones, and *K. oblonga*, J. and K. The relationship, particularly in this instance, is not very close, the valves of *K. subquadrata* being much shorter and more nearly quadrate, with a more distinct umbilical pit, and higher marginal ridge.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

KIRKBYA PARALLELA, n. sp.

Plate XV, Figs. 2 *a, b.*

Size: Length, 0.79 mm.; height. 0.47 mm.

Valves suboblong, with subequal, rounded ends, straight back, and nearly straight ventral margin. Marginal ridge sharply elevated above the narrow, concave border, enclosing the delicately reticulated, and slightly convex body of the valve. Umbilical pit small, scarcely distinguishable.

This species is closely related to *K. oblonga*, Jones and Kirkby, described from the carboniferous limestones of England and Scotland, and recognized now, for the first time, in the Chester shales of Kentucky and Illinois. The latter is illustrated on plate 18 of this paper. Comparing fig. 4*a* of that plate with 2*a* of plate 15, it will be noticed that the outline is almost identical in the

two, but further examination will show that in the Devonian species the marginal ridge is much more elevated, and the reticulated area not nearly so convex.

Position and locality: Same as the preceding.

KIRKBYA SEMIMURALIS, n. sp.

Plate XV, Figs. 3 *a, b,* 4 *a, b, c.*

Size: { Fig. 3*a*; length, 0.7 mm.; height, 0.41.
Fig. 4*a*; " 0.76 " " 0.4.

This species varies somewhat, but may be described as sub-oblong, or elongate elliptical, with a straight back, obtuse cardinal angles, subequal rounded ends, and slightly convex ventral edge. Marginal ridge sharply elevated in the posterior region, but dying out before reaching the anterior end; margin outside of ridge a smooth, convex slope to edge of valve. Within the ridge the depressed-convex surface is delicately reticulated, with the meshes rather large, and extending to the anterior edge. Umbilical pit large but faintly impressed. Valves very thin and frail.

Position and locality: Same as the preceding.

OCTONARIA STIGMATA, n. sp.

Plate XVI, Figs. 8 *a, b*; *var. oblonga, figs.* 9 *a, b, c*; *var. loculosa, fig.* 10.

It is very difficult to distinguish the back from the ventral edge, and the anterior from the posterior end in species of this peculiar genus. If my arrangement of the figures of the three species and varieties on plate 16 is correct, then I have in each case illustrated a right valve. To save time and type we will assume that the parts have been correctly determined.

Species variable; valves with a raised and longitudinally ridged area occupying most of the surface. Ridges more or less irregularly thickened at intervals, or united by a greater or less number of cross-bars, producing a coarse network.

The typical form (figs. 8 *a*, 8 *b*) is ovoid or subrhomboidal in shape, with the anterior extremity the narrowest; posterior end strongly curved in the lower half, sloping forward in the upper

half; ventral edge gently convex, curving neatly up into the anterior curve which is the most prominent above the middle; back straight, without cardinal angles. Counting the marginal ridge of the elevated area, there are five longitudinal ridges in the anterior half. In the posterior half they become irregular.

Size: Length, 0.88 mm.; height, 0.53 mm.

Var. LOCULOSA, n. var., fig. 10.

In this variety the back is short, and both the ends most produced in the lower half. The elevated area is divided into numerous small compartments by cross-bars. Length, 0.85 mm.; height, 0.5 mm.

Var. OBLONGA, n. var., figs. 9a, b, c.

In this variety the ends are subequal, the dorsal and ventral edges parallel or nearly so, and the elevated area divided up in a very irregular manner. Length, 1.21 mm.; height, 0.7 mm.

Though these varieties appear very distinct, I am confident that with sufficient material a complete gradation from one to the other could be established. Very likely *O. linnarasoni*, Jones (Quart. Jour. Geol. Soc., Nov. 1890, p. 541, pl. XX, figs. 7 *a*, 7 *b*,) from the same horizon and locality, represents another form of the same species, with a shape near var. *loculosa*, and the elevated area consisting of a spirally wound ridge. *O. octoformis*, from the Wenlock of England, is another variable species, Prof. Jones having designated no less than seven distinguishable varieties.* Considerable variability may therefore be expected in species of this genus.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

OCTONARIA OVATA, n. sp.

Plate XVI, Figs. 6a, 6b.

Size: Length, 0.75 mm.; height, 0.48 mm.; thickness, 0.45 mm.

This is a true *Octonaria*, with shape and surface markings on the order of *O. octoformis*, Jones, but more nearly elliptical and symmetrical, and with the elevated area divided into more numerous pits. The right valve is somewhat smaller than the left, and straighter at the dorsal margin.

*Ann. and Mag. N. Hist., ser. 5, vol. XIX, 1 sp. 404-407, June, 1887.

The species is distinguished from *O. stigmata* and varieties by its more oval shape, and smaller and differently marked raised area.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

OCTONARIA CLAVIGERA, n. sp.

Plate XVI, Figs. 7 *a, b, c.*

Size: Length, 1.51 mm.; height, 0.77 mm.; thickness of one valve, 0.36 mm.

In this peculiar species the valves are suboblong, the back straight, rather long, and without angular extremities, the ends subequal and semicircular, and the ventral margin moderately convex, with the curve a little the strongest in the posterior half. Elevated area taking up nearly the entire surface, so that the edges of the valves appear to be very thick and concave. Center of area with a number of shallow pits surrounding a club-shaped longitudinal ridge.

Though deviating rather obviously from the ordinary types of *Octonaria*, the characters of this species, as far as determined, do not appear to differ in any really essential respect from those required by the genus.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

OCTONARIA CURTA, n. sp.

Plate XIII, Figs. 4*a*, 4*b*.

Size: Length, 0.78 mm.; height, 0.63 mm.; thickness of one valve, 0.25 mm.

Valves short, oval; elevated area with a simple oval depression, without ridges except an obscure elevation on one side; edges slightly thickened.

This species doubtlessly is related to *O. octoformis*, Jones, occurring in nearly equivalent strata in England, but its valves are shorter, the edges more abrupt, and the surface pattern more simple than in any of the known varieties of that species.

Position and locality: Shales of the Niagara group, Lockport, N. Y.

BYTHOCYPRIS DEVONICA, n. sp.

Plate XVII, Figs. 1 *a, b, c.*

Size: Length, 1.55 mm.; height, 1.01 mm.; thickness, 0.65 mm.

Carapace sub-triangular, ventral edge nearly straight, back strongly arched, ends subequal, the anterior slightly narrower than the posterior. Left valve larger than the right, overlapping it at all sides. Ventral and dorsal edges thick; sides of valves depressed-convex, with point of greatest convexity above the center in the large valve, and as much below it in the smaller.

This form, perhaps, ought to be placed as a variety of *B. phillipsiana*, Jones and Holl, originally described from the Wenlock, but later recognized by Jones and Kirkby in the Carboniferous deposits of England. The outline of the latter, which they distinguish as var. *carbonica*, is almost exactly like that of our Devonian variety, but in end and ventral views the latter is thicker above and below, while the central portion of the valves is less convex. In the Silurian type of the species the dorsal and ventral edges are even more acute in end views.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BYTHOCYPRIS PUNCTULATA, n. sp.

Plate XVII, Figs. 2 *a, b, c.*

Size: Length, 1.93 mm.; height, 1.15 mm.; thickness, 1.14 mm.

Carapace strongly convex, the height and thickness nearly equal; ventral edge straight, curving up at each end; back convex, the outline of the whole nearly semi-circular; greatest thickness of valves in the posterior half. Left valve much the largest, its edge overlapping that of the right valve. Entire surface neatly punctate; punctæ several times their diameter apart.

I have a right valve from the Niagara shales at Lockport, N. Y., that probably belongs to a variety of this species. Its surface is also punctate, but the punctæ are more closely arranged. The valve is also less convex, with the profile in a ventral view is somewhat flattened centrally. If it deserves a name it might be called var. *niagarenesis.*

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BYTHOCYPRIS INDIANENSIS, n. sp.

Plate XVI, Figs. 11 *a, b, c.*

Size of left valve: Length, 1.13 mm.; height, 0.62 mm.; thickness, 0.33 mm.

This species, of which I have seen only the left valve illustrated, is closely related to *B. punctulata*, the chief differences being as follows: *B. indianensis* is comparatively a little longer, has the dorsal edge thicker, slightly grooved and incurved, and the test is not punctate. The species is also very much like *B. hollii*, Jones, from the Wenlock of England, but the profile in end and ventral views is different.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BAIRDIA LEGUMINOIDES, n. sp.

Plate XVII, Figs. 5 *a, b, c.*

Size: Length, 1.42 mm.; height, 0.75 mm.; thickness, 0.55 mm.

Carapace elongate, ends acuminate, subequal, the posterior a little more blunt than the anterior; dorsal edge arched in the middle, concave on each side to the extremities; ventral edge unusually convex, the curve almost uniform. Left valve much larger than the right, with a thick, overlapping edge all around. Right valve with a faintly marked central spot. Both valves more ventricose in the posterior two-thirds than usual in this genus.

The side view resembles that of *B. legumen*, Jones and Kirkby, but in other respects the two species are quite distinct. None of the species described by Reuss and Kirkby present any striking resemblances. *B. leguminoides* seems to differ from them all in having the posterior end blunter than the anterior.

Position and locality: Shales of the Hamilton group, 18 mile creek, N. Y.

PACHYDOMELLA, n. gen.

Carapace exceedingly ventricose; valves thick and strong, the left much the largest, its thick edges overlapping the right valve at all sides. Dorsal side strongly arched, ventral edge more nearly straight, ends subequal. A faintly impressed, subcentral umbilical pit.

The only known species resembles *Xestoleberis*, but the thick valves forbid placing it with that genus. *Bythocypris*, and other genera of that type, also have thin valves, and are never so ventricose. It might perhaps have gone with *Barychilina* were it not for the fact that it has the left valve the largest instead of the right.

PACHYDOMELLA TUMIDA, n. sp.

Plate XIII, Figs. 5 *a*, *b*, *c*.

Size: Length, 1.13 mm.; height, 0.75 mm.; thickness, 0.8 mm.; right valve of same: length, 1.05 mm., height, 0.62 mm.; thickness, 0.48 mm.

Carapace very thick, irregularly ovate, the ventral edge straightened, ends subequal, the anterior a little the narrowest. Right valve smaller than the left, most convex in the posterior half. Left valve overlapping the right, its edges thickened, especially at the dorsal side; point of greatest convexity very nearly central. Umbilical pit obscurely impressed, centrally situated. Surface irregularly wavy, sub-nodose.

The ventricose carapace, thick valves, and rough surface readily distinguish this species.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BARYCHILINA, n. gen.

Carapace small, subrhomboidal or ovate; valves thick, unequal, the right the largest, overlapping the left except in the posterior half of the more or less convex dorsal side; the edges of the valves in this portion of the back are smooth, and resemble a pair of thick lips; (see pl. 13, fig 1*d*) edges of both valves thick and smooth all around, that of the right valve much the heaviest. A sharply-defined narrow or rounded umbilical pit. Surface striate. Type, *Barychilina puncto-striata*, n. sp.

In this remarkable genus we have a superficial ornamentation strikingly similar to that of the Devonian species of *Entomis*, coupled with a restricted umbilical pit (instead of a long furrow) and a thickness of the valves, especially of their edges, that is quite foreign to that genus. The inequality of the valves also is unknown in *Entomis*. The two last characters bring the peculiar genus *Kyamodes*, Jones, to mind, but the lobation of the dorsal

region of the carapace in that genus finds no representation in *Barychilina.* A similar, but coarser longitudinal striation of the valves is found in certain subcarboniferous species that are referred, perhaps erroneously, to *Kirbya.* The *K. costata,* McCoy, illustrated on plate 18, figs. *2a, 2b,* is one of these. It would pass very well as a *Barychilina* and, if it could be shown to have unequal valves, I would not hesitate to place it there.

Of other species that may belong to this genus I will mention *Entomis rhomboidea* and *Primitia (?) wolcotti,* both lately described by Prof. Jones from the Hamilton group of New York and Canada.

BARYCHILINA PUNCTO-STRIATA, n. sp.

Plate XIII, Figs. 1 *a, b, c, d, e,* 2 *a, b, c, and, var. curta,* 3 *a, b, c.*

Size:	Fig. 1, complete example,	length, 1.85 mm.;	height, 1.15 mm.;	thickness, 0.94 mm.
	" 2, left valve,	" 1.55 "	" 0.98 "	" 0.37 "
	" 3, right "	" 1.47 "	" 1.05 "	" 0.35 "

Right valve, subrhomboidal, with the angles rounded off; outline produced in the postero-dorsal and antero-ventral regions; anterior portion of dorsal edge thickened and reflexed; the slit-like umbilical pit situated a short distance behind the center of the antero-dorsal fourth. Left valve more nearly oval, and narrower in front, with the edges, particularly the upper and lower, thickened and incurved to allow the overlap of the right valve. Edges of both valves smooth, the rest of the surface covered with distinct, flexuous longitudinal striæ; in each of the furrows between the striæ a row of small punctures.

Figs. 3 *a, b, c,* are outline representations of a right valve of

Var. CURTA, n. var.

This differs from the typical form in being shorter and not so thick.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BARYCHILINA PULCHELLA, n. sp.

Plate XIII, Figs. 4 *a, b, c, d.*

Size: Length, 1.03 mm.; height, 0.68 mm.; thickness, 0.70 mm.

Carapace short, ventricose, and a little the highest in the posterior half. Right valve subrhomboidal, angles rounded, outline

produced in the antero-ventral and postero-dorsal regions; umbilical pit oval, sharply defined, situated a little in front of the center; margins smooth, thickened on the inner side where they overlap the edges of the smaller left valve except at the straightened dorsal side. Left valve nearly egg-shaped, narrowing anteriorly, with the umbilical pit situated higher than on the opposite valve. Surface of both valves with strong, more or less flexuous longitudinal striæ.

This species resembles *B. punctostriata* in many respects, but is distinguished by being shorter, smaller, and more convex, and in having slightly coarser striæ, no punctæ between them, and the umbilical pit more centrally situated, and of rounded form.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

PART III.

CARBONIFEROUS SPECIES.

LEPERDITIA NICKLESI, n. sp.

Plate XVIII, Figs. 1 *a, b, c, d, e.*

Size: Length, 1.15 mm.; height, 0.77 mm.; thickness (of left valve), 0.25 mm.

Valves small, oval, widest posteriorly; hinge line short, straight; surface almost uniformly convex, often with obscure pimples especially in the posterior half. Eye tubercle represented by a spine-like prominence near the antero-dorsal angle.

The spine distinguishes this species from *L. carbonaria*, (Hall). In *L. armstrongiana*, Jones and Kirkby, the spine is larger and farther removed from the dorsal edge. The latter is longer, and the outline on the whole much less exactly egg-shaped.

Named for Prof. J. M. Nickles, of Sparta, Ill., who was my companion on the trip that resulted in the discovery of this and other interesting species.

Position and locality: Warsaw beds of the St. Louis group, Columbia, Monroe Co., Ill.

PRIMITIA GRANIMARGINATA, n. sp.

Plate XII, Figs. 8 *a, b.*

Size: Length, 0.51 mm.; height, 0.33 mm.

Valves moderately convex, egg-shaped, narrow in front, back straight, ends and ventral edge neatly curved, with a sharply defined flange. The border at each end with a row of small granules. Sulcus represented by a shallow pit just behind the center of valve; on each side of pit a faint impression.

A nearly related species occurs at Chester, Ill. It is a little larger and without granules on the flange.

Position and locality: Chester group shales, near Grayson Springs Station, Ky.

PRIMITIA SIMULANS, n. sp.

(*Not figured.*)

Size of left valve: Length, 0.78 mm.; height, 0.50 mm.; thickness, 0.18 mm.

This outline of the valves of this species is very nearly like plate 12, fig. 8*a*, the difference being that the hinge line is a little shorter, the posterior end very slightly wider and more produced in the lower half, and the ventral edge a trifle straighter. The flange is the same, except that the row of granules is wanting; but the umbilical pit is more central, larger and deeper, and extends as a shallow neck-shaped sulcus to the dorsal border.

Position and locality: Chester group shales, Chester, Ill.

PRIMITIA CESTRIENSIS, n. sp.

(*Typical form not figured; Plate XIV, Figs.* 7 *a, b, c, represents var. caldwellensis.*)

Size: Length, 0.84 mm.; height, 0.54 mm.; thickness, of one valve, 0.16 mm.

Valves moderately convex, in profile flattened centrally; shape very nearly like plate 14, fig. 7 *a*, with the ends a trifle narrower, and the central third of the ventral edge more convex. Flange distinct, wide at the ends, narrow at the ventral margin. Sulcus beginning with a well defined pit at the center of the valves, from which it extends, gradually widening and shallowing, to the dorsal edge.

This, the typical form of the species, has been seen as yet only in the Chester shales at Chester, Ill. What I shall provisionally call

var. CALDWELLENSIS, n. var.,

is represented by figures 7 *a*, *b*, *c*, on plate 14. It occurs at the top of the Chester group in Caldwell Co., Ky., and differs from the typical form in being a little shorter, in having the curve of its ends fuller, and only a centrally situated umbilical pit instead of a sulcus reaching the dorsal margin. The posterior half is also a little less tumid.

Size: Length, 0.79 mm.; height, 0.55 mm.; thickness, 0.15 mm.

PRIMITIA SUBÆQUATA, n. sp.

Plate XIV, Figs. 8 *a*, *b*, *c*.

Size: Length, 0.56 mm.; height, 0.34 mm.; thickness of one valve, 0.15 mm.

Valves suboblong, strongly convex, with straight back, rounded subequal ends, and uniformly curved ventral edge. Flange illy defined, recognizable at the ends only. Umbilical pit central, faintly impressed.

This and the two preceding species are related to the Silurian *P. humilis*, J. and H., but each is distinguished by its own peculiarities, so that, while I am willing to admit their probable descent from that early type, it has seemed desirable, and to the best interest of geology, to view them as specifically distinct. In any event, they are distinguishable, and therefore deserve recognition in our nomenclature.

Position and locality: Top of the Chester group, Claxton P. O., Caldwell Co., Ky.

ULRICHIA EMARGINATA, n. sp.*

Plate XII, Figs. 10 *a, b, c.*

Compare, *Beyrichia tuberculo-spinosa*, Jones and Kirkby, Ann. and Mag. Nat. Hist., Ser. 5, vol. 18, pl. 8, figs. 7 and 8.

Size: Length, 0.61 mm.; height, 0.38 mm.; thickness, 0.24 mm.

This species may not be distinct from the *Beyrichia tuberculo-spinosa*, J. and K., from the Carboniferous deposits of Great Britain, which, in a recent letter, Prof. Jones suggests should be removed to *Ulrichia*. Their species, as figured, differs from *U. emarginata* in being a little longer, in having the cardinal angles sharper, the ventral and posterior margins more convex, and in having no flattened border or flange. There is also a difference in the size and arrangement of the tubercles, but no great importance is to be attached to them since they are liable to vary in those respects.

The Lower Silurian *Primitia nodosa*, or *Ulrichia nodosa* as it should now be called, resembles *U. emarginata* sufficiently to render their generic identity reasonably obvious.

Position and locality: Chester group shales, near Grayson Springs, Ky.

ULRICHIA (?) CONFLUENS, n. sp.

Plate XII, Figs. 11 *a, b.*

Size: Length, 1.35 mm.; height, 0.78 mm.; thickness of left valve, 0.34 mm.

Valves suboblong, slightly oblique; dorsal edge straight, rather long, meeting the anterior curve without forming an angle; anterior end uniformly convex, ventral edge very gently curved, posterior margin obliquely truncate above, rounded and most prominent in the ventral half. Surface with a $\triangle$-shaped depression just above the center; around it, and taking up nearly all of the remaining surface, a low rounded ridge, with a low swelling on it near the central of the ventral margin, a small tubercle at each of the antero-dorsal, antero-ventral, and postero-ventral angles, and two

*The genus *Ulrichia* has just been proposed by Prof. Jones (Quart. Jour. Geol. Soc. for November, 1890,) for the reception of *U. conradi*, Jones, and the group of species mentioned in the remarks on *Primitia nodosa* (*ante* p. 135.) It will be noticed that I there expressed myself as favoring a generic separation from *Primitia*, though totally unaware of the fact that Prof. Jones had arrived at the same conclusion.

low rounded prominences near the dorsal edge where the converging ends of the ridge fail to meet, leaving a sulcus between them.

As interpreted by me this species is near *U. tuberculo-spinosa*, J. and K., and *U. emarginata*, and distinguished from them by confluence of the bases of the tubercles which in those species are distinct. I am confident that the peculiarities of the species are to be accounted for in this manner, and that its affinities are with *Ulrichia* and not with *Primitia*.

Position and locality: Shales of the Chester group, near Grayson Springs, Ky.

BEYRICHIA RADIATA, Jones and Kirkby, var. CESTRIENSIS, n. var.
Plate XIV., Figs. 4 a, b.

Beyrichia radiata, Jones and Kirkby, Ann. Mag. Nat. Hist., ser. 5, vol. 18, pl. 8, figs. 1, 2 *a*, 2 *b*.

Size: Without frill; length, 0.85 mm.; height, 0.5 mm.; height with frill, 0.65 mm.

The Chester shales specimens which I propose to designate as above, are too much like the original figures of *B. radiata* to deserve separation of greater than varietal importance. They differ from the British examples in being a little higher, with the ends also more equal, the frill a little wider and extending more nearly on the same plane with the contact edges of the valves. The surface also is finely papillose all over, a feature that is not exhibited in Jones and Kirkby's figures. The large rounded lobes or tubercles also are of more ovate shape and less unequal in size. These differences may be of sufficient importance to establish the variety.*

Position and locality: Shales of the Chester group, near Grayson Springs, Ky.

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*Since this was written I have looked over a small parcel of washings from shales at the extreme top of the chester in Caldwell County, Ky. Among others I detected three valves that seem to be *identical* with the British types of *B. radiata*. This discovery goes to show that the var. *cestriensis* is not a mere local modification of the species.

BEYRICHIA SIMULATRIX, n. sp.

Plate XVIII, Fig. 7 a, b.

Compare, *Beyrichia fœtoidea*, White and St. John, 1868, Trans. Chicago Acad. Sci., p. 126.

Size: Length, 0.73 mm.; height, 0.42 mm.

Valves obliquely subovate, widest posteriorly, back straight, ends and ventral edge neatly curved. A moderate but well defined flange around the free margins. A large ridge-shaped lobe begins near the center of the posterior margin and, running down to the ventral edge, turns and, at the same time gradually widening, proceeds parallel with the ventral margin nearly to the anterior end. This curved ridge occupies nearly half of the surface. Just above it a very narrow ridge, with a large and very prominent globular termination reaching the dorsal edge, and situated in front of the center. An equal distance behind the center, and not reaching the dorsal margin, a smaller prominence. Entire surface beautifully punctate or minutely recticulate.

The lobation of the valves is much as in *B. fœtoidea*, W. & St. J., described from the upper Coal Measures of Iowa, yet, providing that species is reliably illustrated, there are sufficient differences to count them as distinct. In the Iowa species the ventral lobe is thickest where in this species it is thinnest. Nor does White and St. John's figure show anything of the thin prolongation from the antero-dorsal prominence. The shape of the valves also seems to differ.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs, Ky.

BOLLIA GRANIFERA, n. sp.

Plate XII, Figs. 12 a, b.

Size: Length, 2.1 mm.; height, 1.45 mm.; greatest thickness of right valve, 0.5 mm.

Valves comparatively large, oblique, back long, straight, with well-marked cardinal angles; anterior margin vertical above, then curving backward into the rather strongly convex ventral margin; posterior edge with a bold and nearly uniform curve. Free margins with a strong and wide, concave frill, overhanging and extend-

ing some distance beyond the contact edges. Peripheral portion of frill obscurely crenulated. The generic loop-ridge oblique, with bulbous extremities, the anterior bulb very large, sub-globular, reaching the dorsal edge; its surface is strongly papillose; the posterior bulb much smaller, situated a distance nearly equalling its diameter from the dorsal edge; curved connecting portion of loop ridge-like, rather thin. Surface of valves minutely granulose.

This is the latest known species having the character required by *Bollia.* It is possible that it is not a true descendant of the Silurian and Devonian species of the genus, but may represent a modification from such a *Beyrichia* as the Hamilton *B. tricollina,* illustrated on the same plate (Fig. 6). I know of no Carboniferous species with which it might be confounded, unless it be *Beyrichia radiata.*

Position and locality: Rare in the siliceous debris of the St. Louis limestone, at Elizabethtown, Ky.

MOOREA GRANOSA, n. sp.

Plate XII, Figs. 9 *a, b.*

Size: Length, 0.47 mm.; height, 0.24 mm.; thickness of right valve, 0.1 mm.

Valves oblong, moderately convex, slightly oblique, elongate-subelliptical in outline, with the back straightened, no cardinal angles, the ends rounded, the posterior the widest; ventral edge gently convex. Surface with a low granulose ridge, running parallel with the ends, and very close to the ventral edge. Near center of valve a subcircular, smooth space is encircled by a row of granules. A few granules are distributed also in the area between this space and the submarginal ridge.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs, Ky.

KIRKBYA OBLONGA, Jones and Kirkby, var.

Plate XVIII, Figs. 4 *a, b,* 5 *a, b.*

Kirkbya oblonga, Jones and Kirkby, Ann. Mag. Nat. Hist., Ser. 5, Vol. XV, Plate VIII, Figs. 4–6.

Size: { Fig. 4 *a;* Length, 0.74 mm.; height, 0.43 mm.; thickness, 0.15 mm.
Fig. 5 *a;* " 0.72 " " 0.42 " " 0.18 "

The identity of these American specimens with the British Car-

boniferous *K. oblonga* may be considered as reasonably certain. Slight differences might be pointed out, but considering the variability of the species, it is highly improbable that they would prove constant.

Position and locality: Shaly limestones near the middle of the Chester group, at Chester, Ill., and near Grayson Springs, Ky.

KIRKBYA LINDAHLI, n. sp.

Plate XVIII, Figs. 6 *a, b, c.*

Size: Length, 2.3 mm.; height, 1.3 mm.; thickness of right valve, 0.65 mm.

Valves comparatively large, strongly convex, suboblong-ovate, slightly oblique, widest in the posterior half, with the ends equally curved, the back straightened, the cardinal angles obtuse, the ventral edge straight or very gently convex at the center and curving uniformly up at each end. Marginal ridge thin, nearly equally elevated all around the free margins. Body of valve strongly convex, with point of greatest convexity just behind the center, where a slight protuberance is noticeable. Just in front of this prominence a vertically elongate umbilical pit. Entire surface beautifully reticulate.

This fine species, which it gives me pleasure to name for my friend Dr. Josua Lindahl, State geologist of Illinois, is related to *K. oblonga*, J. & K., but is much larger, with coarser reticulation, and narrow instead of rounded umbilical pit. Other differences might be pointed out, but these will suffice.

Position and locality: Warsaw beds of the St. Louis group, at Columbia, Ill.

KIRKBYA TRICOLLINA, Jones and Kirkby.

Plate XVIII, Figs. 8 *a, b.*

Kirkbya tricollina, Jones and Kirkby, Ann. Mag. Nat. Hist., Ser. 5, Vol. XVIII, Plate VIII, Fig. 19.

Size: Length, 0.75 mm.; height, 0.43 mm.

The American specimens of this species differ in several unimportant respects from the British form as figured by the authors of the species. Chief among these is the greater prominence of the

central one of the three eminences that have suggested the specific name.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs and Leitchfield, Ky.

KIRKBYA VENOSA, n. sp.

Plate XVIII, Figs. 3 a, b.

Size: Length, 0.75 mm.; height, 0.48 mm.; thickness of one valve, 0.15 mm.

Valves subelliptical, symmetrical, with the back straight, ventral edge nearly so, ends semicircular, equal; cardinal angles obtuse. A depressed and slightly concave marginal space, wide at the ends, narrow at the center of the ventral edge, encloses the elevated main body of the valve. This is traversed by flexuous, narrow, vein-like, longitudinal ridges. Spaces between ridges minutely reticulate. Umbilical pit round, situated above the center in a hollow between two of the ridges.

This species is near *K. plicata*, Jones and Kirkby, but in that species there is no depressed marginal area, and the longitudinal ridges or plications are fewer and much more simple.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs, Ky.

KIRKBYA (? BARYCHILINA) COSTATA, (McCoy).

Plate XVIII, Figs. 2 a, b.

Kirkbya costata (McCoy), Jones and Kirkby, Ann. Mag. Nat. Hist., Ser. 5, Vol. XV, Plate VIII, Figs. 13 *a*, *b*.

Size: Length, 2.02 mm.; height, 1.06 mm.; thickness of one valve, 0.50 mm.

Of this species I have seen only a single valve. This does not agree exactly with the valve figured by Jones and Kirkby (it is longer), but the costate ornamentation is so nearly alike in the two that I feel reasonably certain of their identity. When it comes to the generic relations of the species I am much less confident. The general aspect of the valves strikes me as different from that of *Kirkbya*, and more like *Barychilina*. If the species really

belongs to the last genus, then I should regard my specimen as a left valve, and the straighter edge as the ventral.

Position and locality: In England, a Lower Carboniferous fossil; in America, in the Warsaw beds of the St. Louis group, at Columbia, Ill.

CYPRIDINA HERZERI, n. sp.

Plate XIV, Figs. 9 a, b, c.

Size: Length, 1.4 mm.; height, 0.7 mm.; thickness of left valve, 0.47 mm.

Valves strongly convex, suboblong, highest in front of the middle; dorsal side arched, nearly semi-circular, the antero-ventral extremity prolonged beak-like; ventral edge moderately convex except at the anterior end, where it forms the concave lower side of the beak-like prolongation; posterior end rather narrowly rounded. Surface smooth; dorsal and ventral edges of left valve bent inward as though they might have been overlapped by the right valve.

The genus *Cypridina*, Milne-Edwards, is represented by numerous living species in the Pacific and Indian Oceans, and in the fossil state chiefly in the Carboniferous deposits of Europe. The present species is, so far as I am aware, the first of the genus noticed in American rocks. I name it after Rev. H. Herzer, now of Berea, O., who was the first to awaken in me the latent love for nature that has since grown almost to a passion, and become an inexhaustible source of keenest enjoyment.

Position and locality: Near the top of the Waverly series (Keokuk horizon), at Richfield, O.

CYTHERELLA OVATIFORMIS, n. sp.

Plate XVII, Figs. 3, 4 a, b, c.

Size:	Fig. 3;	Right valve:	length, 0.67 mm.;	height, 0.43 mm.
	" 4*a*;	"	" 0.7 "	" 0.43 "
	" 4*b*;	Left	" 0.6 "	" 0.33 "

Carapace slightly elongate, but almost regularly oval, compressed convex, with point of greatest thickness near the posterior end. A very faintly impressed or merely discolored central spot in each valve. Interior of the large (right) valve with a distinct

marginal furrow into which the edge of the smaller valve is inserted.

This species is shorter and thicker than the Warsaw *C. glandella*, Whitfield. In most respects it resembles the European Tertiary species *C. compressa* (Von Münster) Bosquet, very closely.

Position and locality: Shaly limestones at the top of the Chester group, Caldwell Co., Ky.

BAIRDIA CESTRIENSIS, n. sp.

Plate XVII, Figs. 6 *a, b, c,* 7 *a, b.*

Size:	Fig. 6;	length, 1.05 mm.;	height, 0.57 mm.;	thickness, 0.45 mm.
	" 7:	" 0.85 "	" 0.4 "	" 0.32 "

Carapace strongly convex, drawn out and pointed posteriorly, narrowly rounded anteriorly, with the centro-dorsal margin arched, the antero-dorsal straight, the postero-dorsal gently concave; ventral edge nearly straight in the middle, strongly bent upward in front, and only a little behind.

Related to *B. ventricosa*, Kirkby, but is shorter, with the anterior end less acute, the postero-dorsal margin less concave, and the ventral on the whole more convex.

Position and locality: Shales of the Chester group, near Grayson Springs, Ky.

PONTOCYPRIS (?) ACUMINATA, n. sp.

Plate XVII, Figs. 8 *a, b, c.*

Size: Length, 2.37 mm.; height, 0.85 mm.; thickness of one valve, 0.46 mm.

Of this species I have seen only a single valve. The generic relations are therefore in doubt. If it is really a *Pontocypris* then it is a left valve and correctly figured. If, on the other hand, it should belong to a very elongate *Bairdia* (like *B. mucronata*, Reuss, or *B. siliquoides*, J. & K., but relatively longer), it would be a right valve and the most convex edge the ventral. Provisionally, or until a complete carapace is found, the species had best be arranged as above.

Left valve very elongate, acuminate behind, narrowly rounded in front, with the dorsal side curved uniformly, about equal to a one fourth segment of a circle; ventral side very gently convex except at the posterior extremity where it bends a little downward to form a more acute point. Surface smooth, strongly convex, with the thickest part very near the center. Ventral edge curving inward slightly, indicating that the opposite valve overlapped.

Position and locality: Lower Waverly, Moots' Run, near Granville, Ohio. The valve is attached to a fragment of a ferruginous nodule received from Mr. E. M. Cooper.

THE GENUS SPHENOPHYLLUM.

By J. S. Newberry.

(Read November 11, 1890.)

Many years ago I found in my father's coal mines at Talmadge, Ohio, a number of specimens of *Sphenophyllum erosum*, L. & H., which showed more of the structure of the plant than was before known, viz., the stems, the branches, the leaves of two forms—some normally wedge-shaped with serrated extremities, others deeply cut, fimbriated or divided into linear segments—and the fruit in different stages of development; all these so connected that there could be no doubt about their belonging to the same plant.

At the meeting of the American Association at Cleveland in 1853, I read a paper upon the structure of certain fossil plants found in northern Ohio and among others described these specimens of *Sphenophyllum*. Abstracts of this paper, with some figures, were published in the Proceedings of the American Association, Vol. VII, p. 157, and in the Annals of Science, Vol. I, 1853, p. 268.

In speaking of the relations of *Asterophyllites* and *Sphenophyllum*, I said: "The jointed, striated stem, the verticillate arrangement of the leaves and similar fructification, have been considered as proofs of the close affinity of these two genera, but the wedge-shaped leaves of *Sphenophyllum* have been regarded as distinctive. Some of the species of these genera should, however, be united, as they were different portions of the same plant, *Asterophyllites* being the lower part with numerous capillary or linear leaves, while *Sphenophyllum* was the upper part with broad wedge-shaped leaves. The difference of form between the superior and inferior leaves of *Sphenophyllum* would seem to indicate that it was an aquatic plant, the submerged leaves being linear, uni-nerved, almost capillary, and the emerged leaves broad, with a compound nervation, precisely as in many recent aquatic plants."

In 1864, M. M. Eug. Coemans and J. J. Kickx, published in the Bulletin de L'Academie Royal de Belgique, 2 Serie, Tome XVIII, No. 8, a "Monographie des Sphenophyllum d'Europe," in which

they review and compare the species known up to that time. In the general remarks on the genus, page 9, these authors say:

"Les *Sphenophyllum* etaient sans doute des vegetaux aquatiques ou des plantes de marais; plusieurs espaces, notamment les *Sphenophyllum emarginatum* et *S. saxifragaefolium*, a cote des feuilles typiques nous en montrent d'autres, inferieures et plus ou moins profoundement decoupees, a peu pres comme on l'observe oujourd'hui sur plusieures especes du genre Batrachium. Comme dans ce dernier cas, ces feuilles modifiees des Sphenophyllum etaient probablement submergees, et cette observation, qui n'avait pas encore ete faite, nous semble d'une grande valeur pour determiner le milieu dans lequel vivaient autrefois ces plantes."

It will be seen from the above quotation that ten years after the publication of my notes on *Sphenophyllum*, my observations on the difference between the emerged and submerged leaves were confirmed by the Belgian palaeontologists with no knowledge that I had published the same facts.

In 1869, Prof. W. P. Schimper issued the first volume of his Palaeontologie Vegetale, and on page 338 copies the paragraph quoted above with no reference to my notes or figures.

On Plate XIX, Figs. 1, 2, 3, 4 represent the diversity in the vegetative organs in *Sphenophyllum* more clearly than has heretofore been made known. Figure 1 is what I have supposed to be an emerged branch, such as occurred at the top of the plant on which the leaves are wedge-shaped, truncate, serrate and are traversed by dichotomous nerves which terminate in the teeth of the margin. Normally there are six leaves in a verticil. Figure 2 represents a branchlet lower down on the plant, in which the leaves are deeply divided generally into two lobes of which the extremities are split. Figure 3 represents a branch still lower down in which the leaves are all reduced to simple filaments and are very numerous, probably eighteen in a whorl, but it is not easy to determine their exact number. Figure 4 is a larger branch with its verticils of capillary leaves. Such a specimen would be accepted anywhere among fossil botanists as a species of *Asterophyllites* and there is little doubt that several of the species of this ill-defined genus are but submerged portions of *Sphenophyllum*. Figure 9 represents the main stem of a plant of *Sphenophyllum;* it is jointed at short intervals and gives off branches like Figure 4 from the joints. The surface is longitudinally striated and obscurely ridged as are the joints of the branches; it is very much flattened and apparently had little woody tissue in it.

The fructification of *Sphenophyllum* is shown in many fruit spikes associated with the leaves and stems just described and supported on stems like figure 4. These fruit spikes are when complete eight inches or more in length; when immature they are invested with leaf-like bracts which are prolonged above into a brush-like summit. The bracts seem to have been deciduous, for we find many specimens like figure 7 from which they have disappeared and the surface is occupied by numerous approximated whorls, each composed of a large number of closely set obtuse scales, (sporangia?) within or behind which are spores.

The question of the botanical relations of *Sphenophyllum* has been much discussed. Brogniart early suggested that it was allied to *Marsilia*, but in his Tableau des Genres, (1849) p. 53, he places it with *Annularia* and *Asterophyllites* in a special family between the Marsiliaceæ and Equisetaceæ.

Lindley and Hutton, (Fossil Flora, Vol. I, p. 43,) compare *Sphenophyllum* with the Coniferæ and specially with *Salisburia*, but Brogniart has clearly shown that there is quite as little resemblance with the Coniferæ as with the Marsiliaceæ. The verticillate arrangement of the leaves is a character common in *Marsilia*, and but rare in the Coniferæ, and the number of leaves in a whorl never exceeds three; also the whole habit of the plant was different from that of any conifer known. It was small, spreading, herbaceous or frutescent, having very little wood tissue and was aquatic in habit. In its jointed and striated stem, the pronounced verticillate arrangement of the leaves, and in its fructification, *Sphenophyllum* has a much stronger resemblance to the Equisetaceæ than to either the Marsiliaceæ or Coniferæ. The fruit spikes have also much the same structure as those of the Lycopodiaceæ, though the vegetative organs, as well as the general habit, were very different.

Taking all the evidence into account, we are compelled to regard *Sphenophyllum* as representing a peculiar and extinct family of plants that flourished in all parts of the world during the Devonian and Carboniferous ages. They disappeared at the close of the Permian and have no nearer relative in our living flora than *Equisetum*.

While the genus *Sphenophyllum* is so distinctly defined, about the species there is much confusion. This is due partially to the inherent variability of the plant, but more from the difference be-

tween the emerged, the partially submerged and deeply submerged leaves. Usually the descriptions have been based upon fragments and it will only be when larger specimens, showing more of the plant, are compared that the synonymy will be cleared up. I have received from American localities what I have regarded as representatives of the following species.

1. *Sphenophyllum Schlotheimi*, Brgt. This is the most widespread and abundant species in the Coal Measures of North America as well as Europe. It does not occur in the flora of the lowest coal in the Mississippi valley, but begins midway of the lower coal group and runs through the upper productive Coal Measures.

2. *Sphenophyllum erosum*, L. & H. This is common in the flora of the lower coal, quite rare above; sometimes the leaves are much larger than those represented on figure 1 of our plate. They are broad wedge-shaped, normally six in a whorl, with strong and nearly uniform teeth across the straight truncated edge of the end of the leaf. As they descend on the stem they become laciniate by the splitting of the extremity of the leaf into two lobes, each of which is bi-furcate. This is the variety *Saxifragaefolium* of European authors. It may include *S. bifurcatum*, Lx., as suggested by Schimper, but I have from the lower coal of northern Ohio what seems to be the Arkansaw plant and which is characterized by a long-jointed, deeply-fluted stem quite unlike that of the normal form of *S. erosum*.

3. *Sphenophyllum filiculmis*, Lx. This beautiful species I have from the upper Coal Measures of Ohio, Pennsylvania and Rhode Island. It is not always slender-stemmed as the name would indicate, but may be recognized by its narrow strap-shaped toothed leaves of which two are deflected and are very short.

4. *Sphenophyllum oblongifolium*, Germar. This occurs sparingly in Ohio and Pennsylvania, but is the most common species in Missouri and Kansas. The length of the leaves varies somewhat, but is generally from one-quarter to one-third of an inch; the outline is oblong, narrowed to the base, the summit bifid and toothed.

5. *Sphenophyllum angustifolium*, Germ. Of this species the leaves are from one-half to five-eighths of an inch long; narrow, laciniate at the summit with acute teeth; generally six in a whorl, sometimes twelve; not uncommon at Talmadge and Youngstown, Ohio, in the roof shale of coal No. 1.

6. *Sphenophyllum longifolium*, Germ. This is a large species of

which the leaves are an inch or more in length, broadly triangular in outline, coarsely toothed at the summit, which is more or less deeply bilobed. It occurs in the upper half of the Coal Measures, somewhat rarely in Pennsylvania and Ohio, more abundantly in Illinois.

Several other species of *Sphenophyllum* have been described by Lesquereux and White and Fontaine, but I have not had an opportunity of studying them from the specimens themselves.

In 1887, Dr. Dionys Stur, Director of the Geological Survey of Austria, published his "Flora der Schatzlarer Schichten" in which he claims that the genera *Asterophyllites* and *Sphenophyllum* were not distinct and both were the foliage of *Calamites*. And in January, 1890, Mr. A.C. Seward, F. G. S., of St. John's College, Cambridge, sent a paper to the Manchester Literary and Philosophical Society with the title "*Sphenophyllum* as a Branch of *Asterophyllites*." This paper was subsequently published in the Memoirs and Proceedings of this society. Mr. Seward agrees with Dr. Stur that *Asterophyllites* and *Sphenophyllum* are parts of the same plant, but considers it not proven that they are the twigs and leaves of *Calamites*. He also questions the explanation offered first by myself and subsequently by Coemans and Kickx, that the difference between the wedge-shaped and filiform leaves on the same plant was due to emergence and submergence, and quotes Schimper [Handbuch der Palaeontologie] as stating that the absence of intercellular spaces in the stem of *Sphenophyllum* negatives the usual explanation that the finely dissected leaf form is the result of modification brought about by submersion. But my specimens seem to fully confirm my views of the difference as expressed in 1853. In these only the upper branches have the wedge-shaped leaves, the lower portions of the plant being all furnished with those that are, capillary or acicular; precisely the difference that we find in *Cabomba*, *Ranunculus* and other aquatic, but not completely submerged plants. I therefore contend that this explanation is not only the most natural and plausible, but the only comprehensible one.

Sphenophyllum was closely allied to *Annularia* and this was certainly aquatic, for I have seen a rock surface six feet square completely covered with the slender branches and discoid verticils of leaves which must have floated on the surface of water.

That *Sphenophyllum* was the foliage of *Calamites* I doubt. In the plate which accompanies this paper, fig. 9 represents a large stem of *Sphenophyllum*. It will be seen to be jointed; but not striated like *Calamites*. That all these plants were affiliated, and allied to *Equisetum*, seems highly probable, and that some so-called species of *Asterophyllites* were the foliage of *Calamites* can hardly be denied, but these had only filiform and no wedge-shaped leaves.

Plate I.

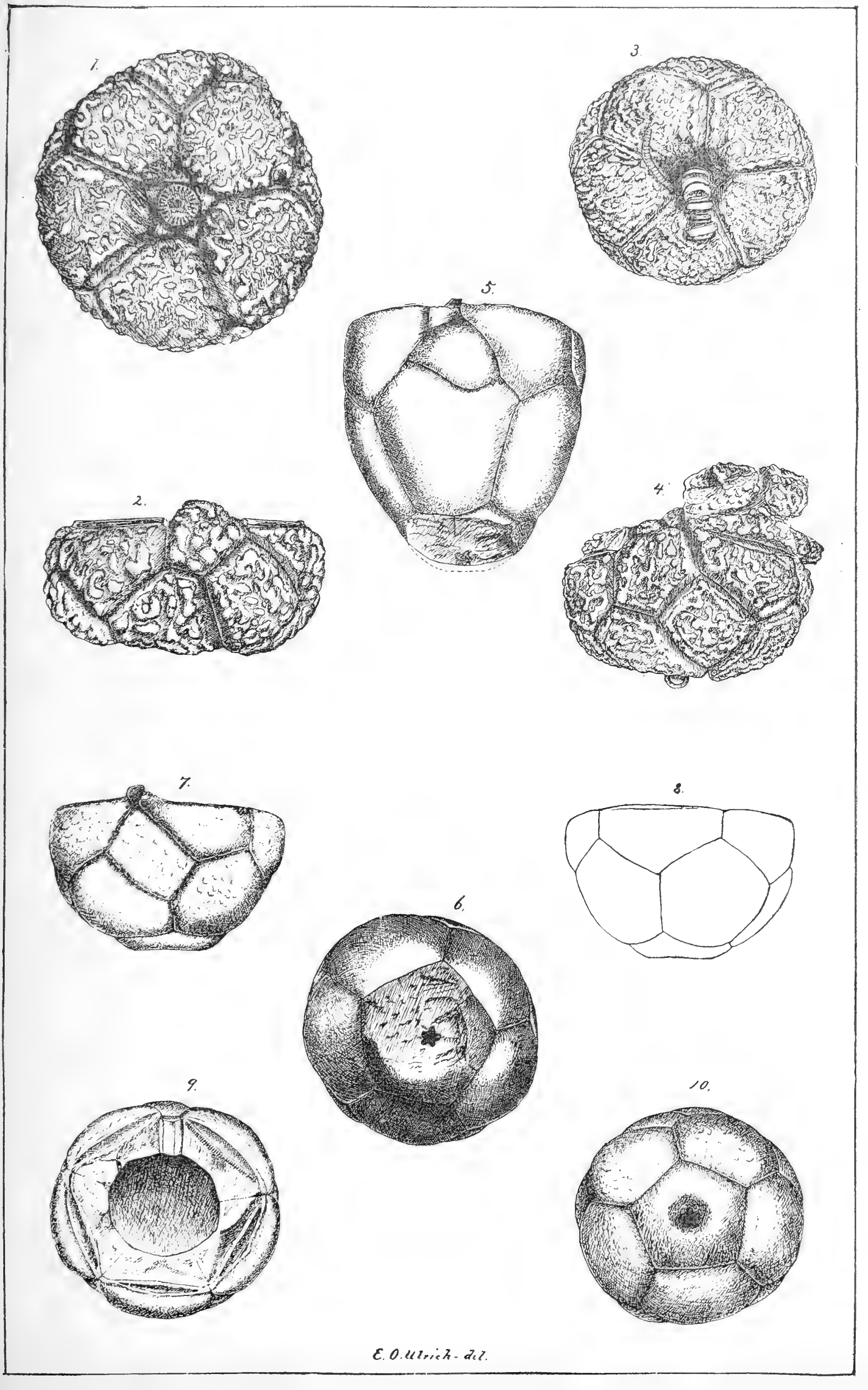
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Plate II.

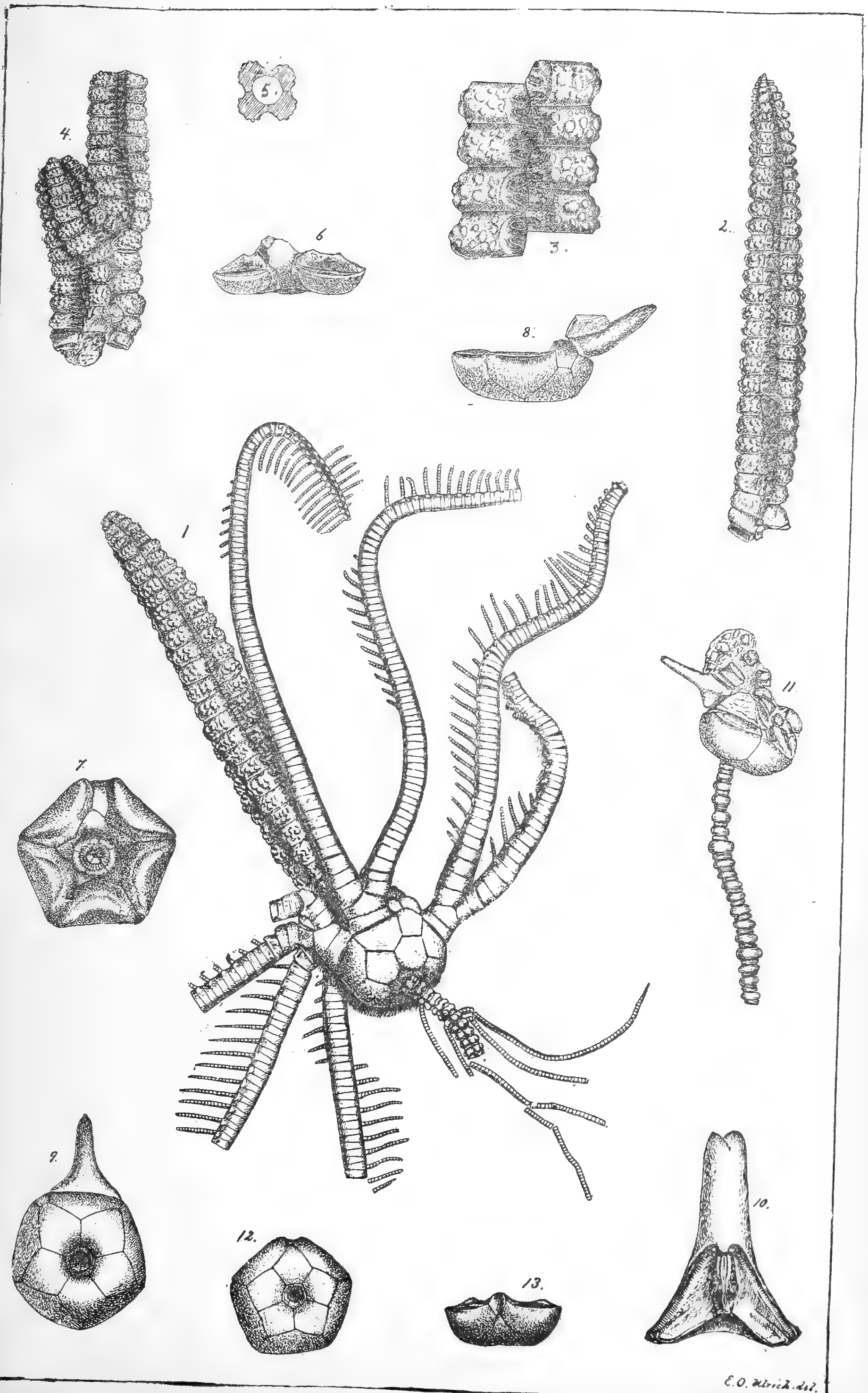
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Plate III.

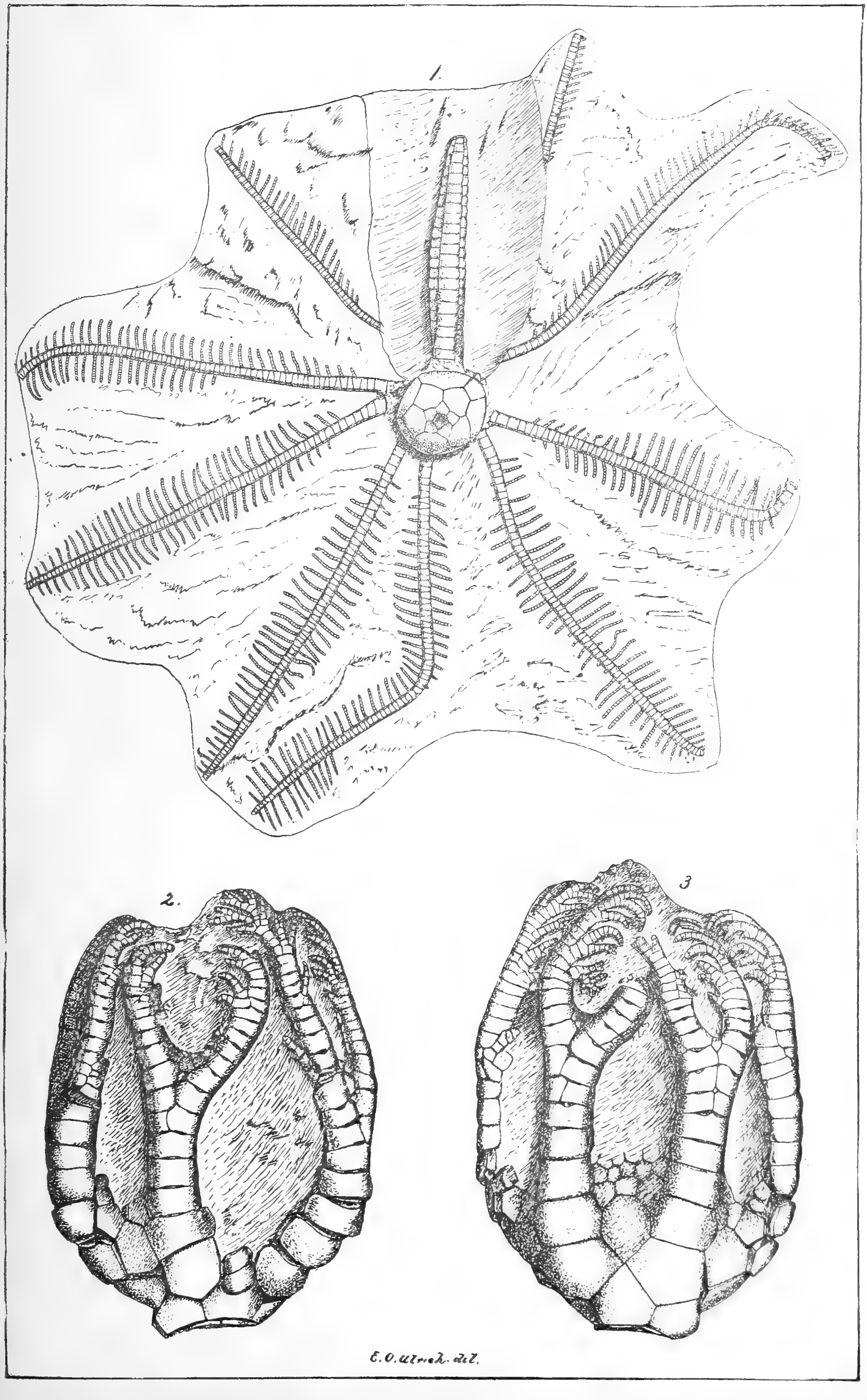
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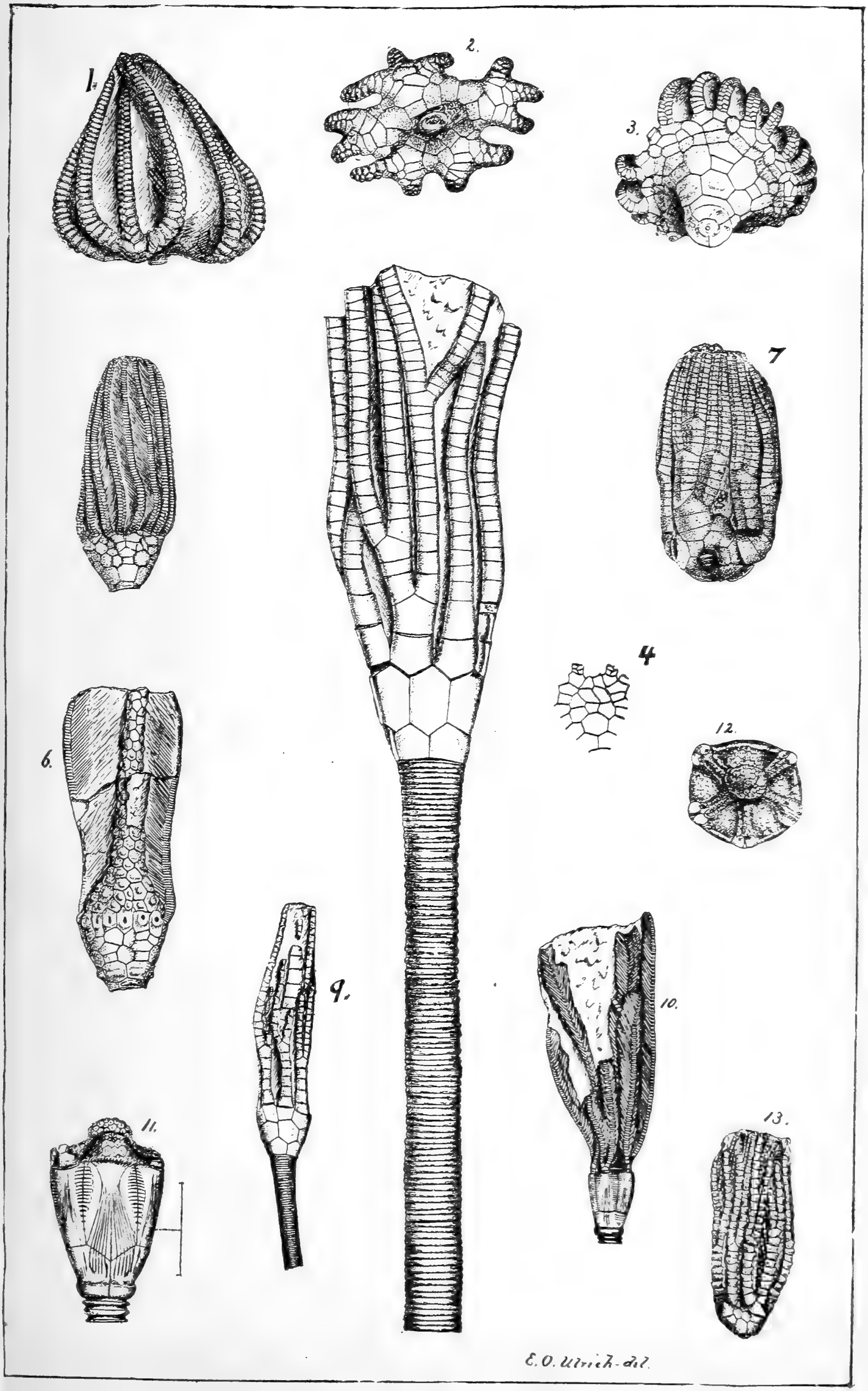
Plate IV.

The Journal Cin. Soc. Nat. History

Vol. XIII. *Plate 4.*



The Journal Cin. Soc. Natural History

Vol. XIII. *Plate 5.*

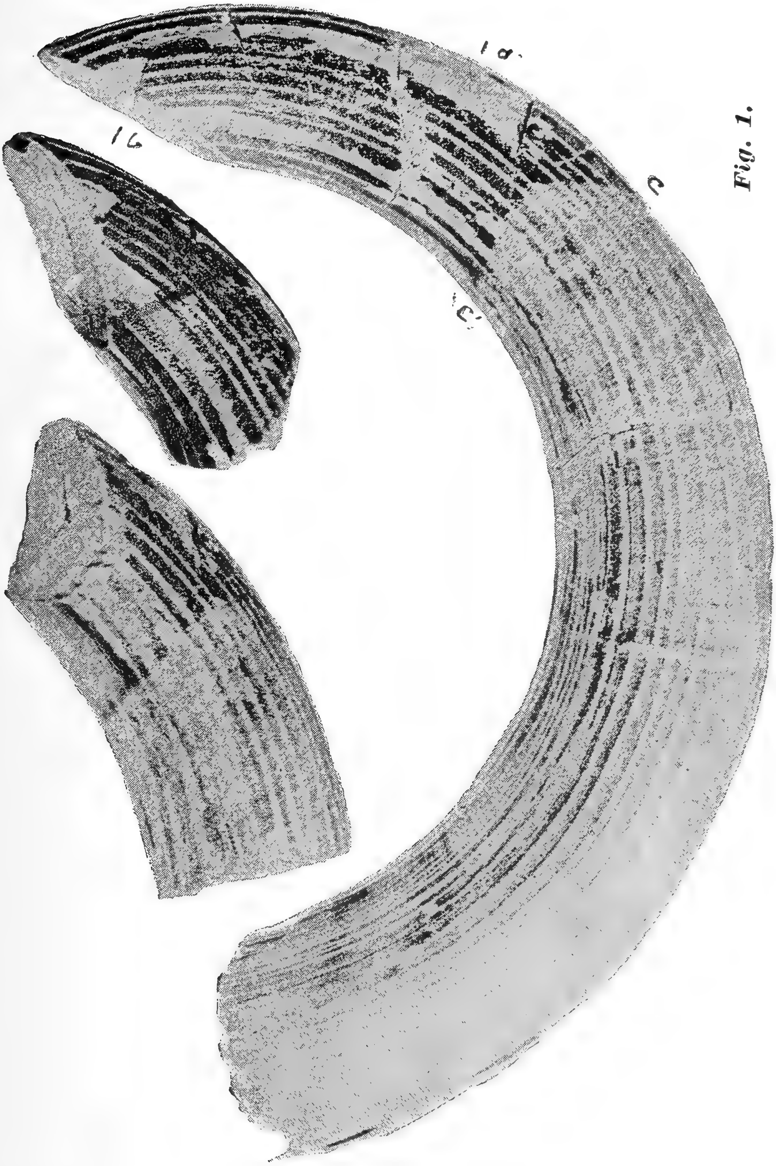


Fig. 1.

Fig. 2.

Fig. 3.

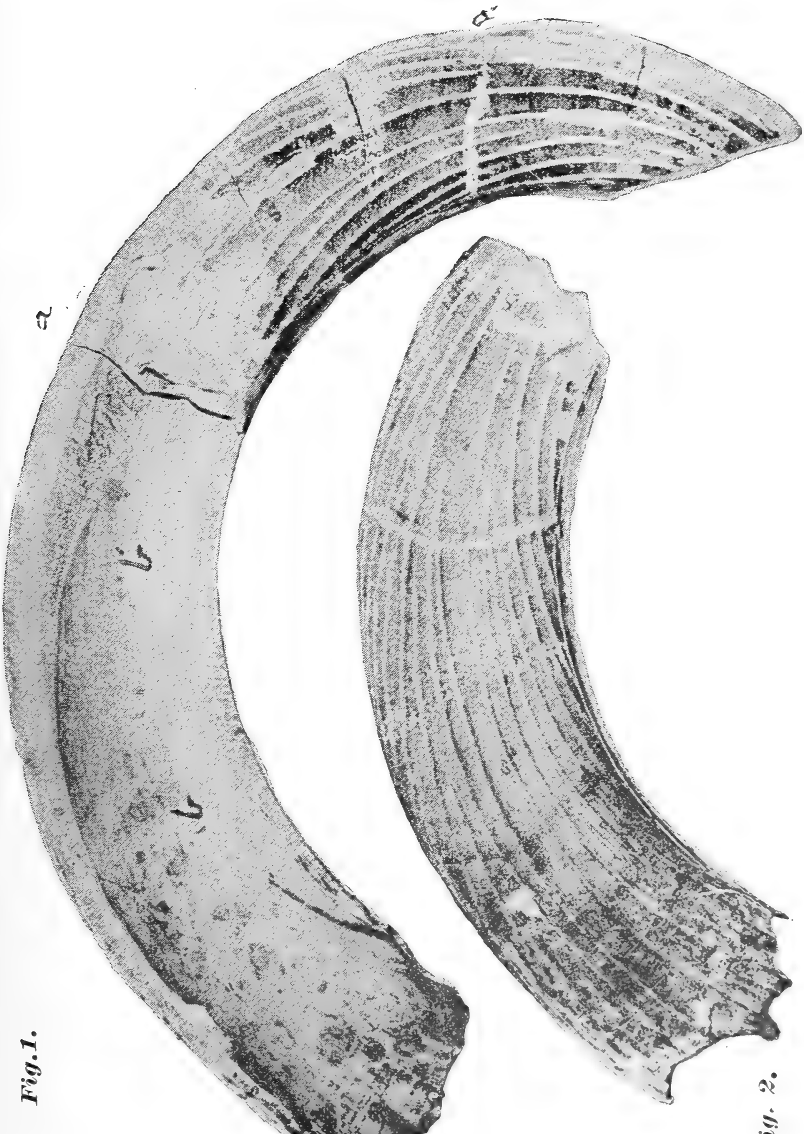


Fig. 1.

Fig. 2.

Plate VII.

Page.

Fig. 1. Ctenobolbina ciliata, (Emmons)................. 108

1*a*, left valve of average specimen, x 18 : 1*b*, interior of right valve, x 18.

Fig. 2. Ctenobolbina ciliata, var. curta, n. var............. 109

Left valve, x 18.

Fig. 3. Ctenobolbina ciliata, var. emaciata, n. var.......... 109

3*a*, left valve, x 20 ; 3*b*, posterior view of same ; 3*c*, ventral view of same.

Fig. 4. Ctenobolbina alata, n. sp......................... 110

4*a*, left side of small example, x 18 ; 4*b* and 4*c*, ventral and dorsal views of two larger specimens, x 25.

Fig. 5. Ctenobolbina tumida, n. sp........................ 111

5*a*, left valve, x 18, with the anterior ridge less sharply elevated than usual ; 5*b*, dorsal view of same in outline.

Fig. 6. Ctenobolbina bispinosa, n. sp...................... 110

Rather small, perfect right valve, x 18.

Fig. 7. Primitia perminima, n. sp......................... 131

Right valve, x 18.

Fig. 8. Jonesella crepidiformis, Ulrich..................... 122

8*a*, right side of an average example of this species, x 18 ; 8*b* and 8*c*, ventral and posterior views of same.

Fig. 9. Jonesella pedigera, n. sp.......................... 122

9*a*, left valve, x 18 ; 9*a*, posterior view of same.

Fig. 10. Jonesella digitata, n. sp......................... 122

10*a*, right valve, x 20 ; 10*b* and 10*c*, dorsal and posterior views of same.

Fig. 11. Jonesella crassa, n. sp........................... 123

11*a* left valve, x 20 ; 11*b*, dorsal view of same.

Fig. 12. Entomis madisonensis, n. sp...................... 107

12*a*, left valve, x 18 ; 12*b*, ventral view of same.

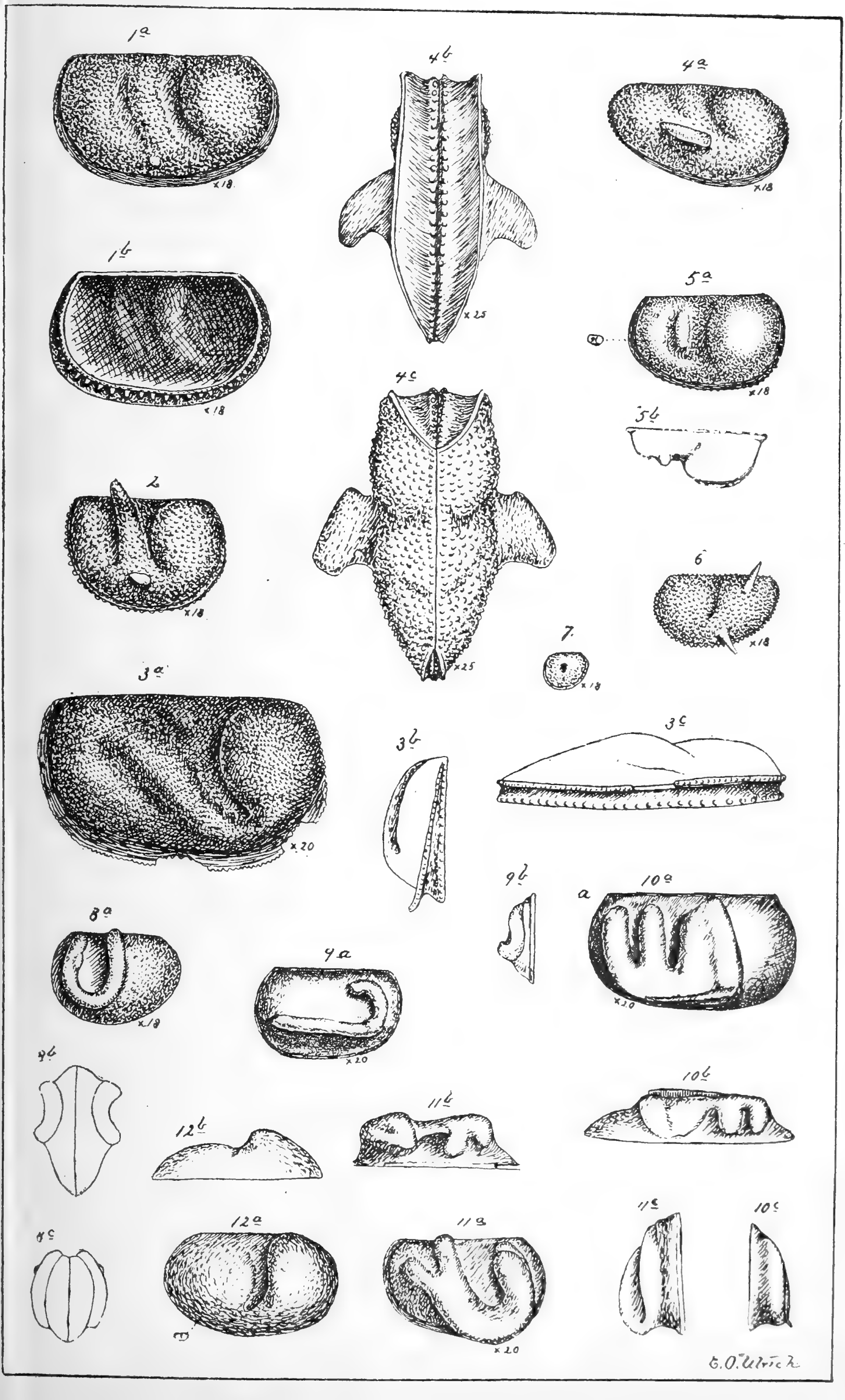

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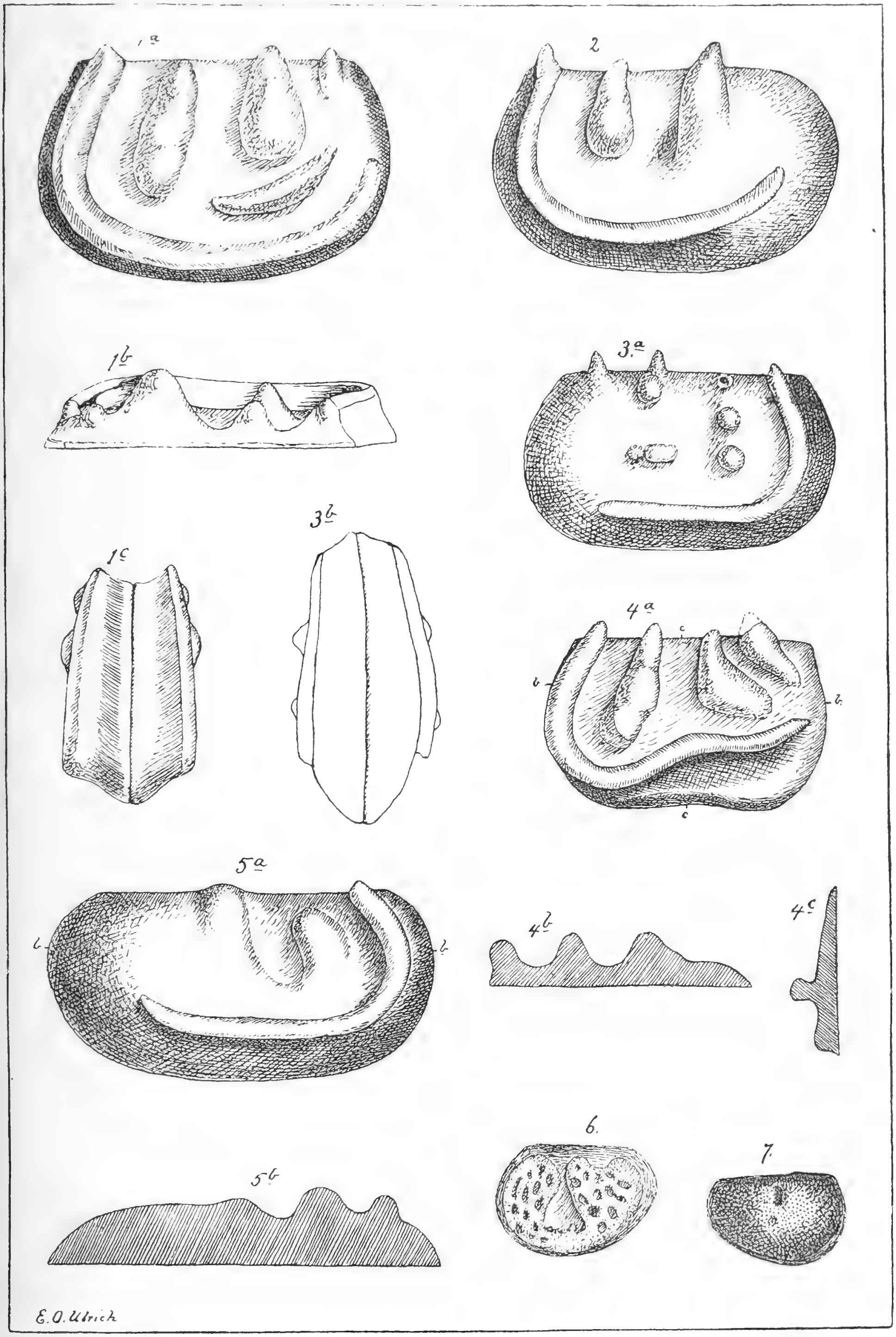
Plate VIII.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7.
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Plate IX.

All the figures on this plate are magnified eighteen diameters.

Page.

Figs. 1 and 2. Eurychilina subradiata, n. sp. 126

1*a*, 1*b* and 1*c*, left valve, from Lebanon, Tenn., with profiles between points marked on margin of fig. 1*a*; 2*a*, 2*b* and 2*c*, right valve, from Dixon, Ill., with similar profiles.

Figs. 3 and 4. Eurychilina longula, n. sp. 127

3*a*, large left valve, showing the interior, with the concave marginal area and "frill"; 3*b*, vertical profile of same; 4, right valve, showing the external features of the species. Both specimens are from the Birdseye limestone, at High Bridge, Ky.

Figs. 5, 6, 7 and 8. Eurychilina æqualis, n. sp. 129

5, an example from Lebanon, Tenn., on which the marginal area is exceedingly wide; 6*a*, 6*b* and 6*c*, left valve of the usual type, from High Bridge, Ky, with vertical and longitudinal profiles; 7, very young example, from same locality; 8, an unusually elongate right valve, from the same locality as 6 and 7.

Figs. 9, 10, 11 and 12. Eurychilina granosa, n. sp. 128

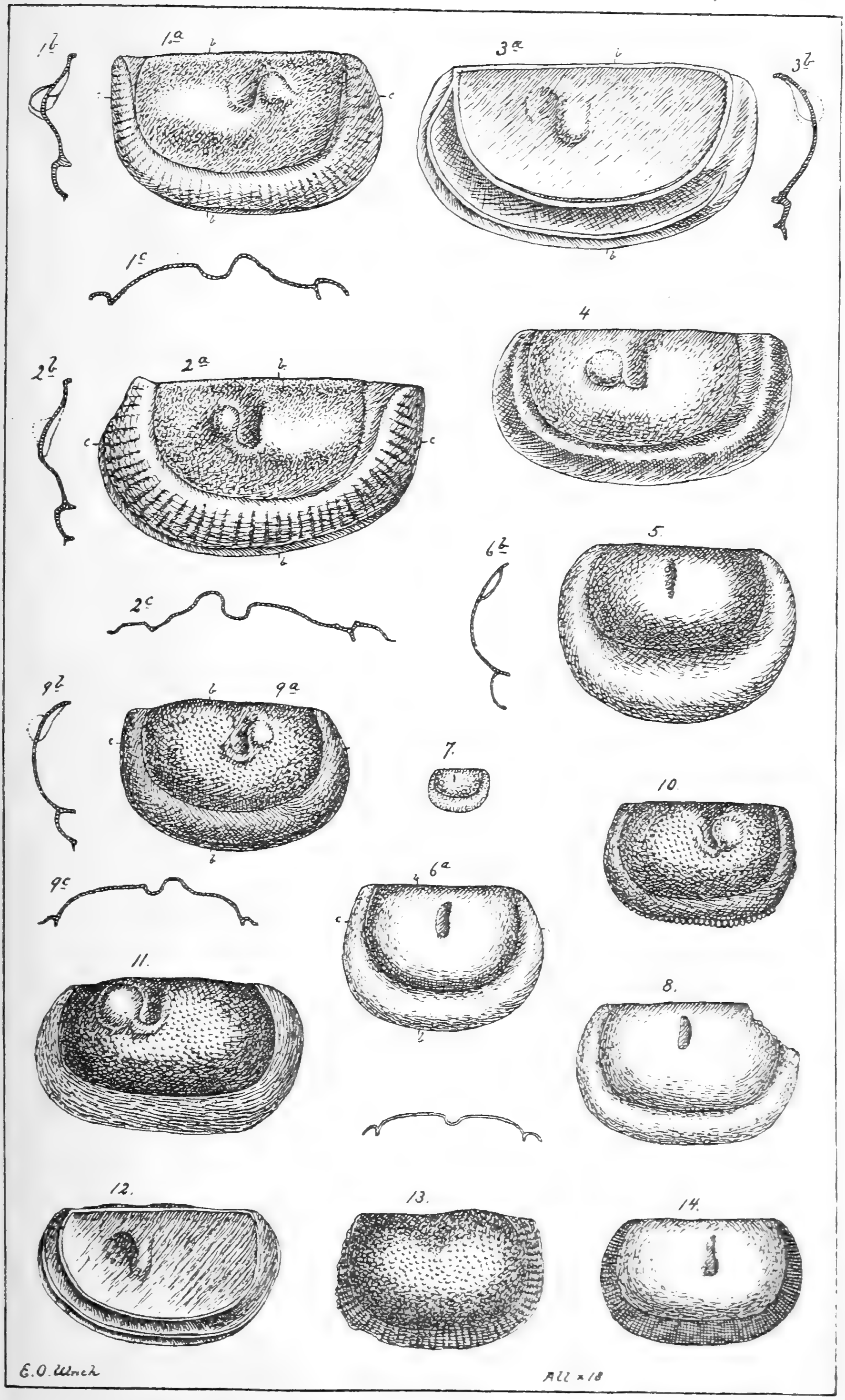
9*a*, 9*b* and 9*c*, average left valve, with vertical and longitudinal profiles; 10, young left valve, with a spinous fringe; 11, elongate variety, right valve, having larger tubercle, and the marginal area covered with interrupted concentric striæ; 12, interior of a left valve.

Fig. 13. Eurychilina obesa, n. sp. 129

Left valve, showing the faint sulcus, granulose surface, and grano-radiate margin. Birdseye limestone, High Bridge, Ky.

Fig. 14. Eurychilina striatomarginata, (S. A. Miller) 130

Left valve, from Southern Indiana, with the sulcus not reaching the dorsal edge. In some examples it seems to do so.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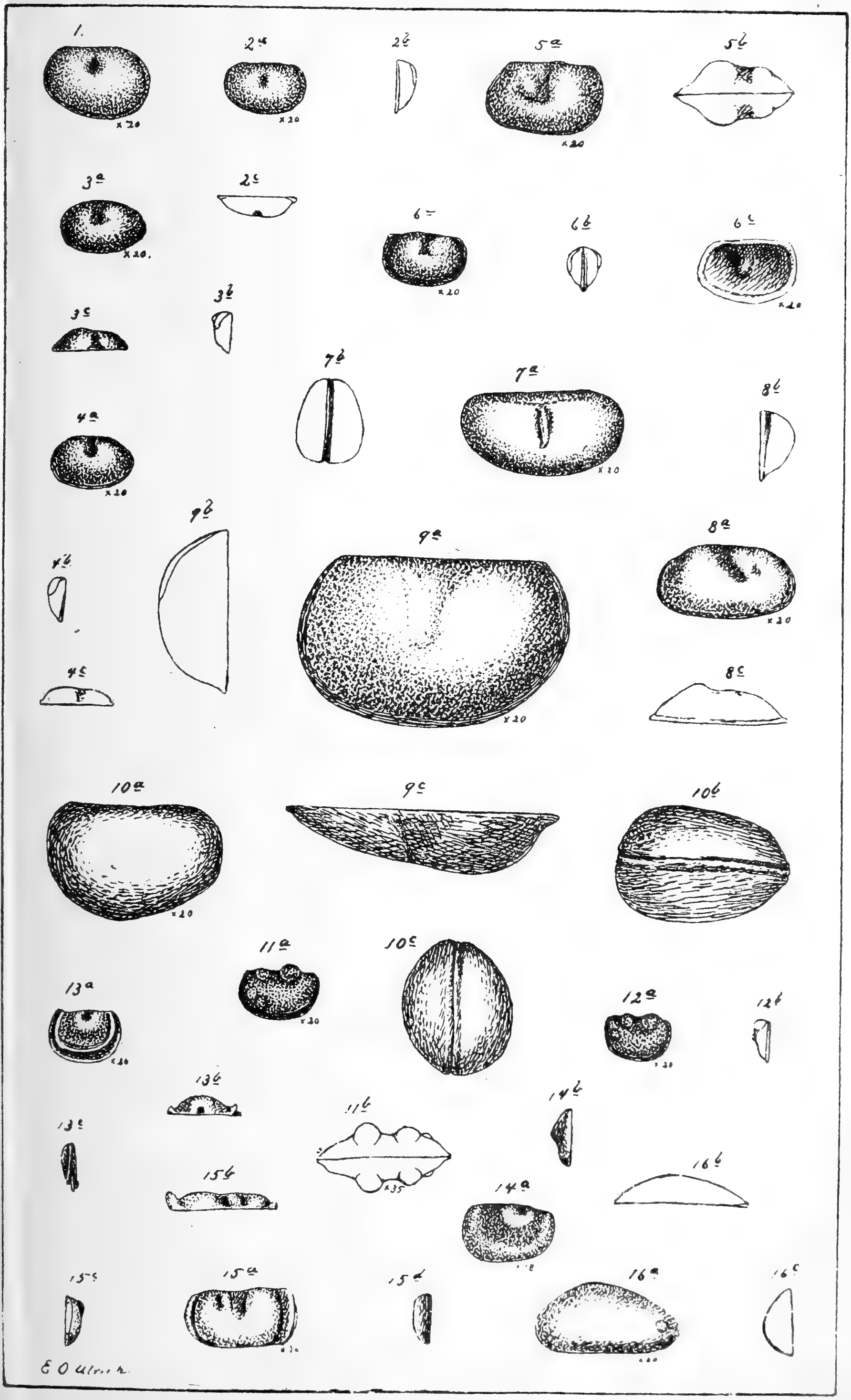
All × 18

Plate X.

All species illustrated on this plate are from the Cincinnati Group, and all the figures, unless otherwise marked, are magnified twenty diameters.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11b
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16b
15b
14a
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15d
16a
16c
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Plate XI.

Page.

Figs. 1 and 2. Leperditia fabulites, Conrad 173

1*a*, 1*b*, 1*c* and 1*d*, left, end, right, and ventral views of a complete example of this species, natural size, from Beloit, Wis.

2. Interior of right valve, from Lebanon, Tenn., x 2, showing the two rows of papillæ within the ventral edge, the radiately marked muscle spot, and the eye spot.

Fig. 3. Leperditia linneyi, n. sp 174

3*a*, left valve, x 2, from near Harrodsburg, Ky.

3*b* and 3*c*, posterior and ventral views of same, x 2.

3*d*, right valve, x 2; 3*e*, anterior view of same, x 2.

Fig. 4. Leperditia tumidula, n. sp 175

4*a*, 4*b* and 4*c*, side, posterior, and ventral views of a right valve, x 2, from Danville, Ky.

Fig. 5. Leperditia appressa, n. sp 176

5*a*, 5*b* and 5*c*, side, anterior, and ventral views of a left valve, x 2, from Harrodsburg, Ky.

5*d*, outline view, natural size, of a large left valve, from Danville, Ky.

Fig. 6. Leperditia cæcigena, S. A. Miller 176

6*a*, a large right valve, x 3, showing a small eye spot.

6*b*, 6*c* and 6*d*, left side, posterior, and ventral views, x 3, of a complete example, of medium size. Both of these specimens are from near Madison, Ind.

Fig. 7. Isochilina subnodosa, n. sp 177

7*a*, 7*b* and 7*c*, side, anterior, and ventral views of rather small left valve, x 2, from Perryville, Ky.

Fig. 8. Isochilina ampla, n. sp 179

8*a*, 8*b*, 8*c*, side, anterior, and ventral views of a right valve, natural size. Nashville, Tenn.

8*d*, interior of another right valve, natural size, showing eye, and reticulated muscle spot; Nashville, Tenn.

Fig. 9. Ishochilina jonesi, Wetherby 179

9*a*, 9*b* and 9*c*, three views of a large left valve, natural size, from near Harrodsburg, Ky.

Fig. 10. Isochilina saffordi, n. sp 178

10*a*, 10*b* and 10*c*, three views of a large left valve, natural size, from Nashville, Tenn.

10*d*, small portion of surface, x 3, showing the grano-reticulate surface ornamentation.

Fig. 11. Isochilina Kentuckyensis, n. sp 179

11*a*, 11*b* and 11*c*, side, anterior, and ventral views, x 2, of a left valve, from Mercer Co., Ky.

11*d*, ventral spine and small portion of margin, x 4, to show the row of small pits.

Fig. 12. Isochilina amiana, n. sp 180

12*a*, 12*b* and 12*c*, side, end, and ventral views, x 2, of an average right valve, from Ottawa, Can.

Fig. 13. Isochilina amiana, var. insignis, n. var 181

A right valve, x 2, occurring with the typical form of the species.

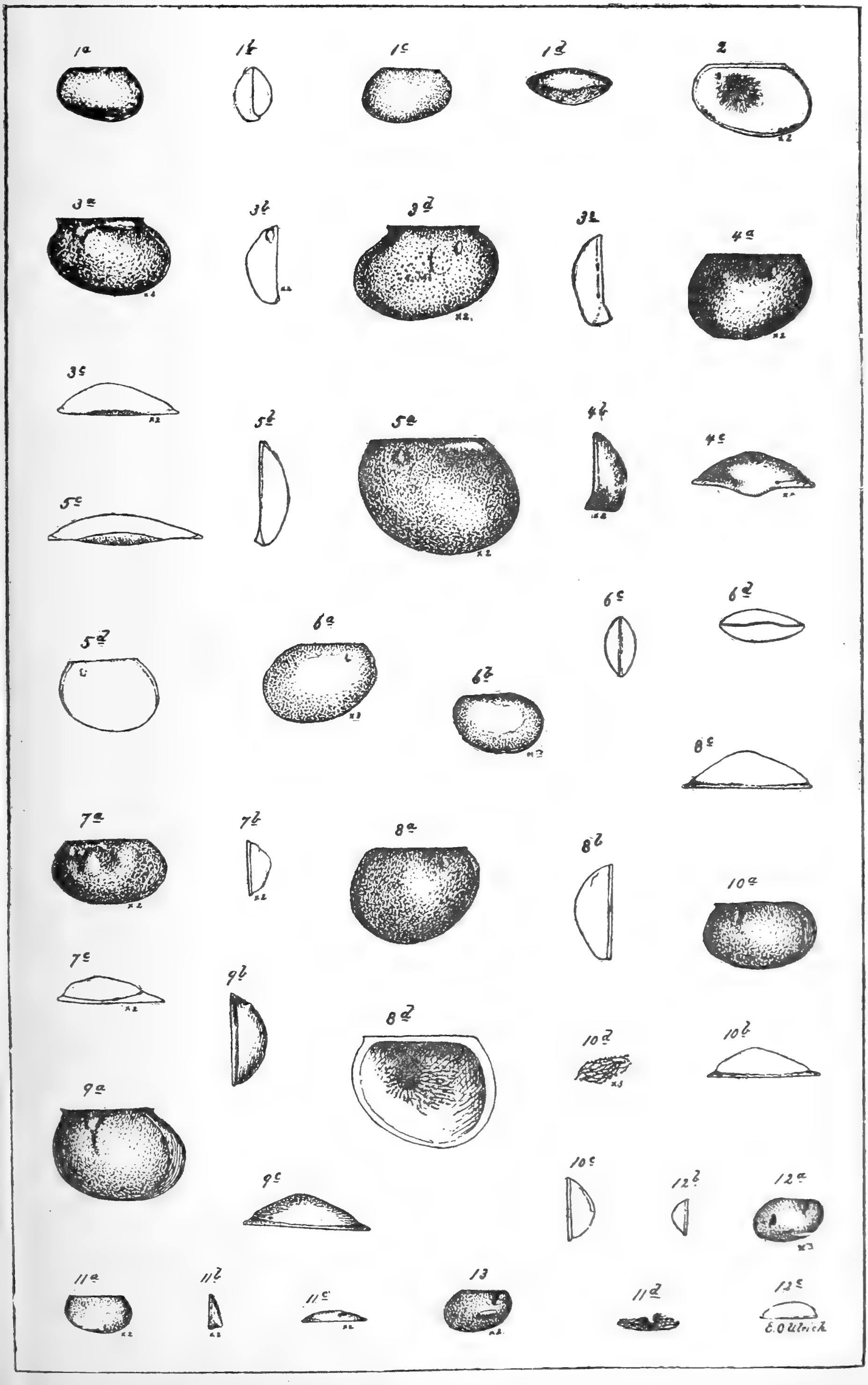
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Plate XII.

Page.

Fig. 1. Bollia pumila, n. sp. 117

1*a* and 1*b*, side and end views of a valve of this species, x 20; from near Weisburg, Ind.

Fig. 2. Primitia milleri, n. sp. 133

2*a*, left valve, x 20, from near Weisburg, Ind. The entire surface is beautifully punctate as shown at a small spot.

2*b* and 2*c*, ventral and anterior views of same.

Fig. 3. Entomis waldronensis, n. sp. 183

3*a* and 3*b*, side and dorsal views of a right valve, natural size.

Fig. 4. Octonaria curta, n. sp. 195

4*a* and 4*b*, side and ventral views of a valve of this species, x 20, from Lockport, N. Y.

Fig. 5. Ctenobolbina punctata, n. sp. 186

5*a*, 5*b* and 5*c*, three views of a right valve, x 20, from Lockport, N. Y.

Fig. 6. Beyrichia tricollina, n. sp. 189

A right valve, x 20, with the frill broken away at the anterior end; from 18 mile creek, N. Y.

Fig. 7. Æchmina abnormis, n. sp. 183

7*a* and 7*b*, side and anterior views of a right valve, x 20, from Lockport, N. Y.

Fig. 8. Primitia granimarginata, n. sp. 201

8*a*, left valve, x 28, from near Grayson Springs, Ky. The small granules at the margin are not well shown in the figure.

8*b*, another valve, in outline, x 28, differing slightly in shape.

Fig. 9. Moorea granosa, n. sp. 206

9*a* and 9*b*, side and ventral views, x 28, of a right valve.

Fig. 10. Ulrichia emarginata, n. sp. 203

10*a*, 10*b* and 10*c*, three views of an entire carapace, x 28.

Fig. 11. Ulrichia confluens, n. sp. 203

11*a* and 11*b*, side and dorsal views of a left valve, x 20.

Fig. 12. Bollia granifera, n. sp. 205

12*a* and 12*b*, side and posterior views of a right valve, x 20.

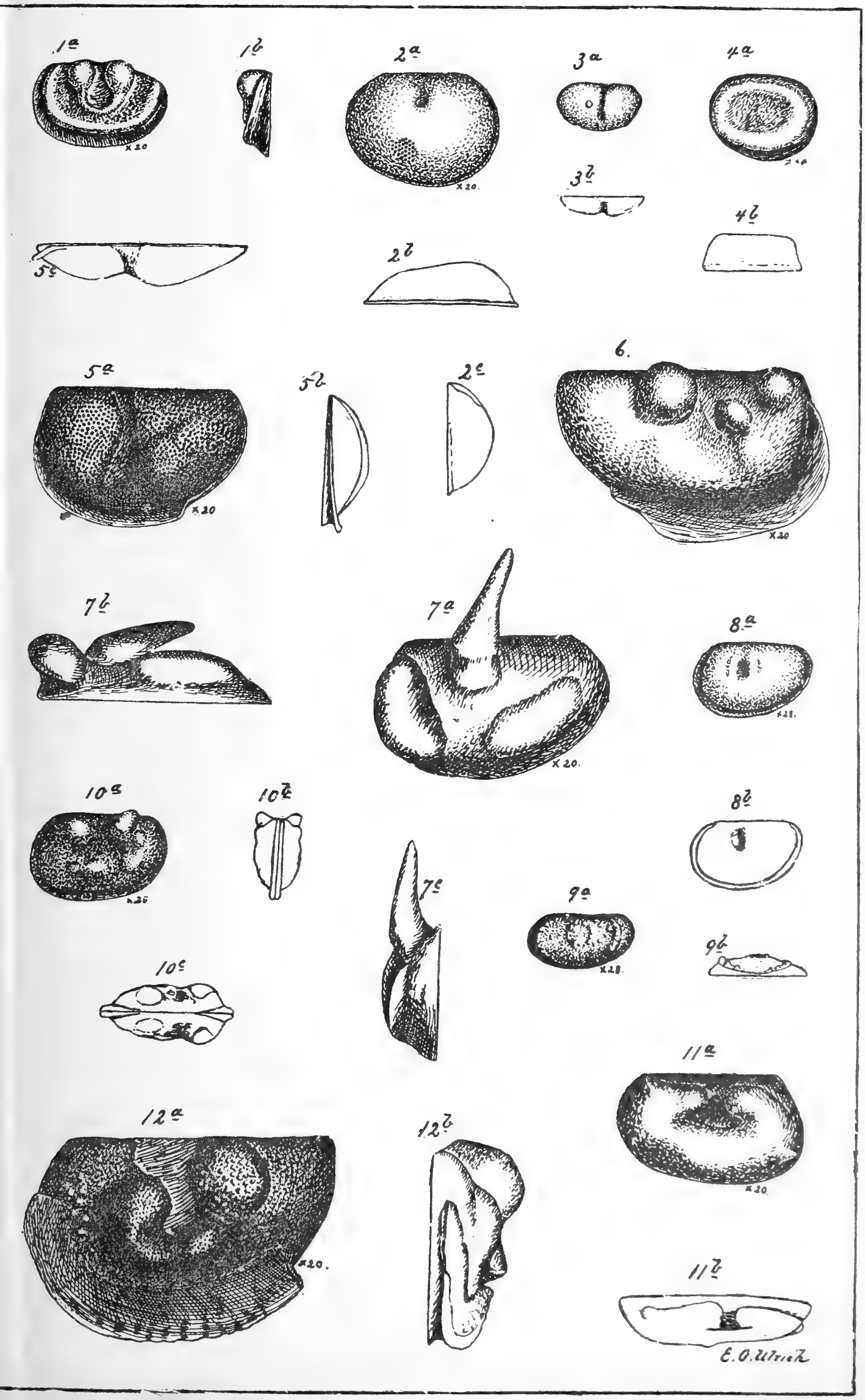
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Plate XIII.

Page.

Figs. 1 and 2. Barychilina punctostriata, n. gen. et sp 199

1a, right side, *1b*, left side, *1c*, posterior end, and *1d*, dorsal view of a perfect carapace, x 20. Falls of the Ohio.

1e, small portion of surface, x 75, showing rows of punctures between the striæ.

2a, *2b* and *2c*, three views, x 20, of a worn left valve.

Fig. 3. Barychilina punctostriata, var. curta, n. sp 199

3a, *3b* and *3c*, outline views of a right valve, x 20.

Fig. 4. Barychilina pulchella, n. sp 199

4a, *4b*, *4c* and *4d*, right side, left side, dorsal, and posterior views of an entire carapace, x 28 (*4d*, x 20.) Falls of the Ohio.

Fig. 5. Pachydomella tumida, n. gen. et sp 198

5a, right side, *5b*, anterior end, *5c*, dorsal view of a complete example, x 28. Falls of the Ohio.

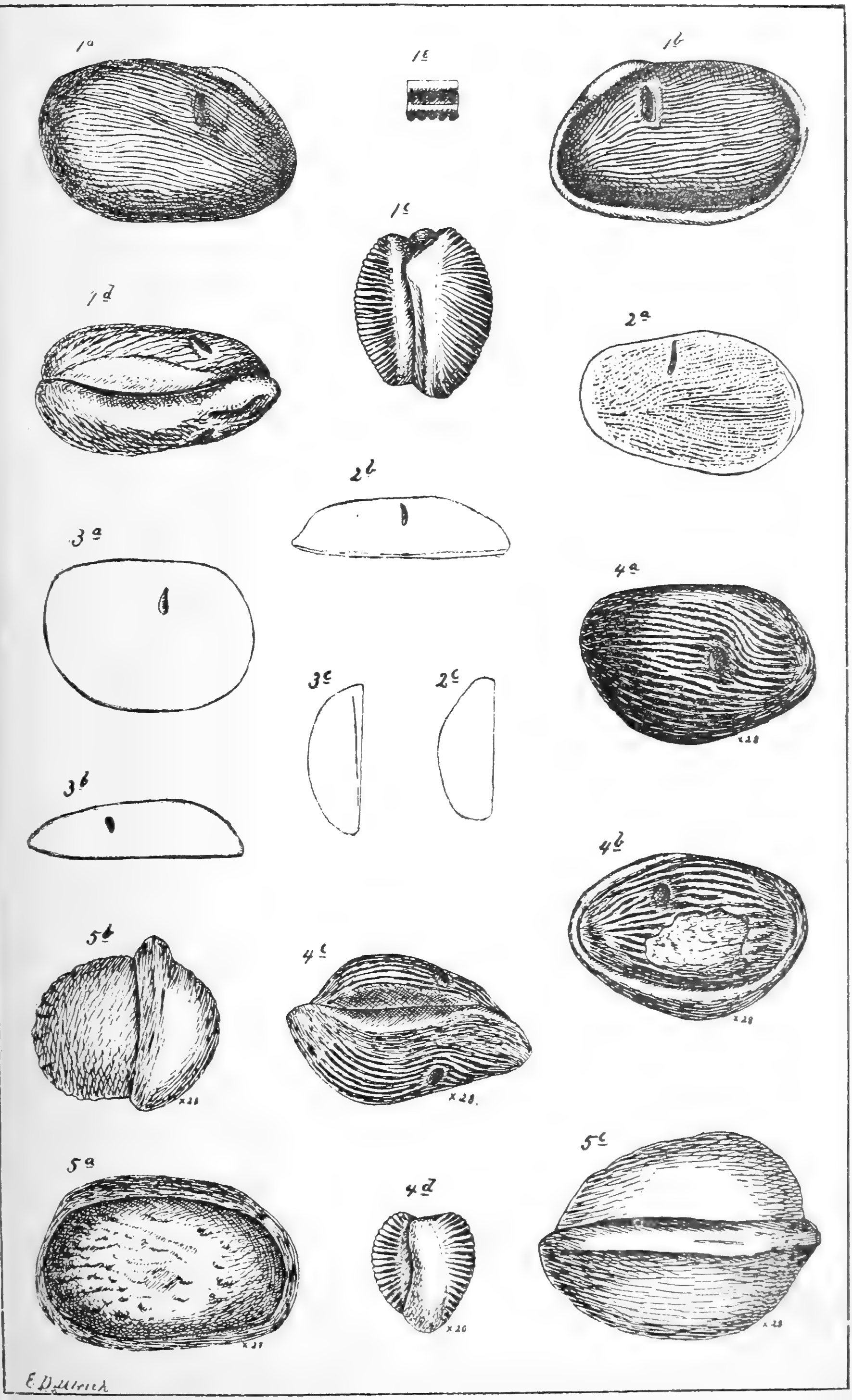
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Plate XIV.

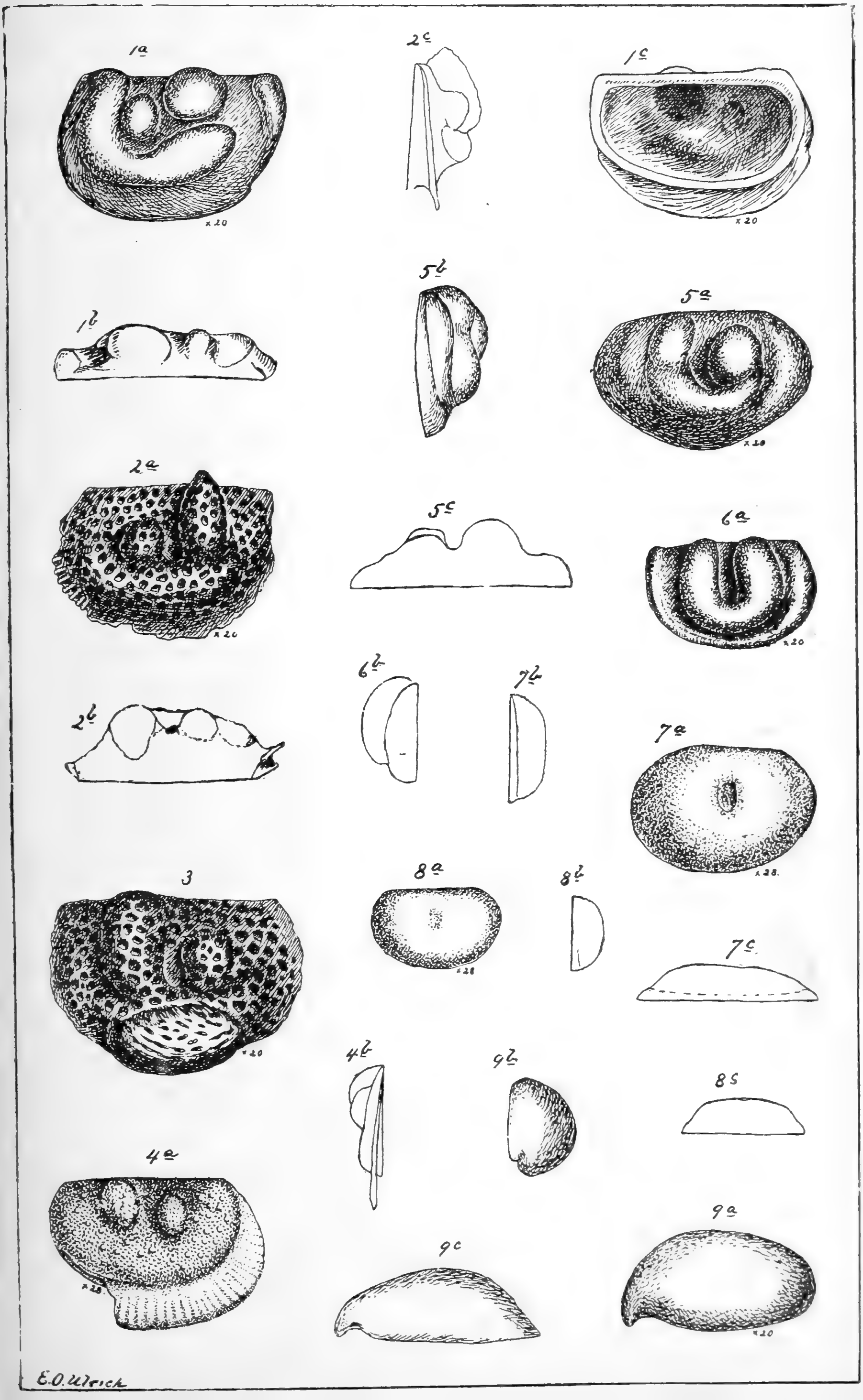

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Plate XV.

Page.

Fig. 1. Kirkbya subquadrata, n. sp. 192

1*a*, 1*b* and 1*c*, side, posterior, and dorsal views of a right valve, x 28. Falls of the Ohio.

Fig. 2. Kirkbya parallela, n. sp. 192

2*a* and 2*b*, side and posterior views of a right valve, x 28. Falls of the Ohio.

Figs. 3 and 4. Kirkbya semimuralis, n. sp. 193

3*a* and 3*b*, side and ventral views, x 28, of a rather short right valve.

4*a*, 4*b* and 4*c*, side, ventral, and posterior views, x 28, of a longer and otherwise different right valve. Falls of the Ohio.

Fig. 5. Halliella retifera, n. gen. et sp. 185

5*a* and 5*b*, side and posterior views of a right valve, x 20.

5*b* and 5*d*, ventral and side views of a left valve, x 20.

5*e*, interior of another left valve, x 20. Falls of the Ohio.

Fig. 6. Ctenobolbina informis, n. sp. 187

6*a*, 6*b* and 6*c*, side, posterior, and ventral views of a right valve, x 20. Falls of the Ohio.

Fig. 7. Ctenobolbina minima, n. sp. 188

A right valve, x 20. 18 mile creek, N. Y.

Fig. 8. Ctenobolbina papillosa, n. sp. 186

8*a*, 8*b* and 8*c*, side, posterior, and ventral views of a left valve, x 20. Falls of the Ohio.

Fig. 9. Ctenobolbina antespinosa, n. sp. 187

9*a*, 9*b* and 9*c*, side, dorsal, and posterior views of a left valve, x 20. The frill is broken away at the ends. Falls of the Ohio.

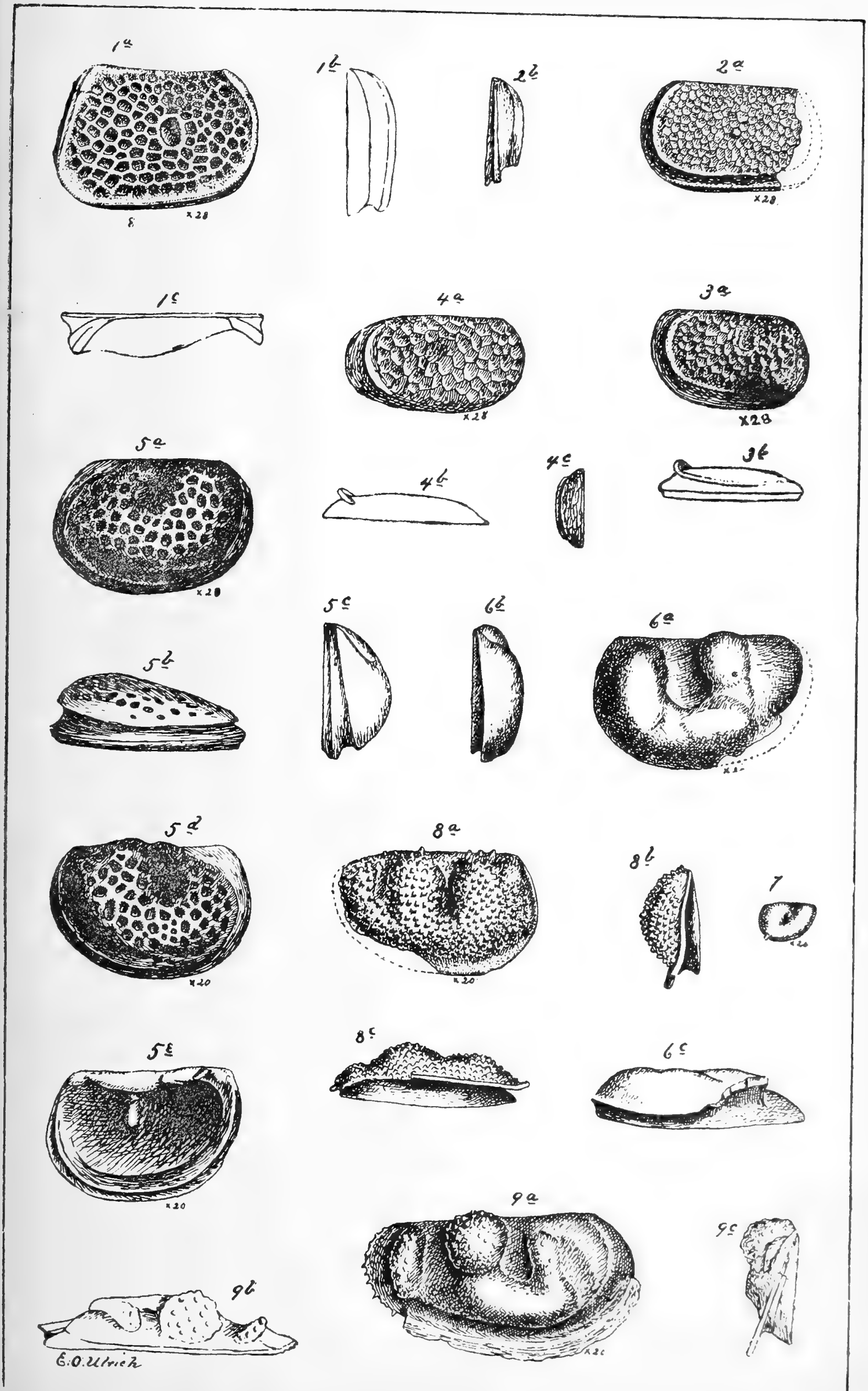
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Plate XVI.

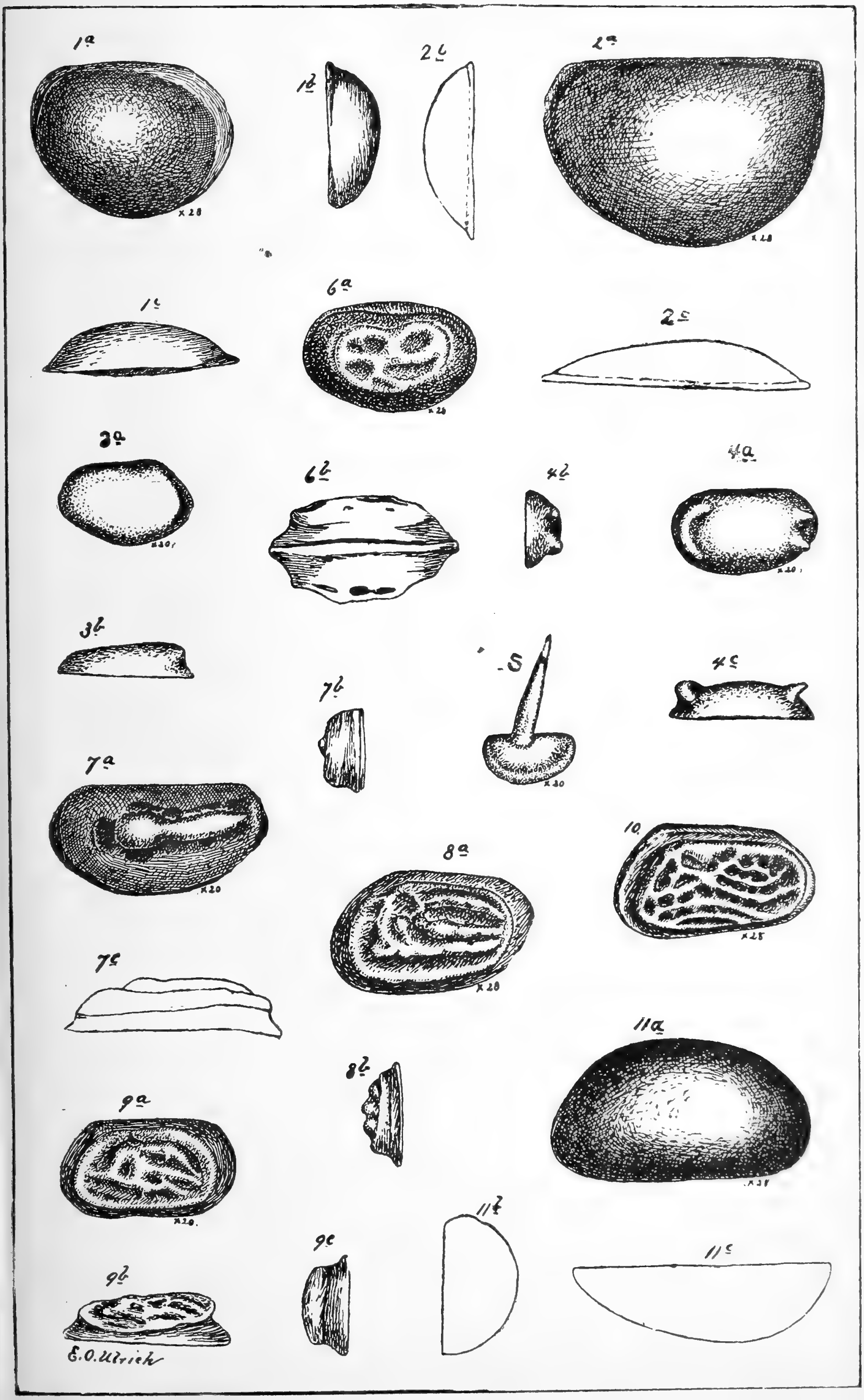


Plate XVII.

Page.

Fig. 1. Bythocypris devonica, n. sp.......................... 196

1a, *1b* and *1c*, right side, posterior, and ventral views of a perfect carapace, x 20. Falls of the Ohio.

Fig. 2. Bythocypris punctulata, n. sp.......................... 196

2a, *2b* and *2c*, right side, anterior, and ventral views of a complete carapace, x 20. Falls of the Ohio.

Figs. 3 and 4. Cytherella ovatiformis, n. sp*............. 209

*Figs. 3, 4*a*, *b* and *c*, are reversed on the plate.

3, interior of a right valve, x 28.

4*a*, 4*b* and 4*c*, three views of a complete carapace, x 28. Caldwell Co., Ky.

Fig. 5. Bairdia leguminoides, n. sp....................... 197

5*a*, 5*b* and 5*c*, right side, ventral, and anterior views of a perfect carapace, x 20. 18 mile creek, N. Y.

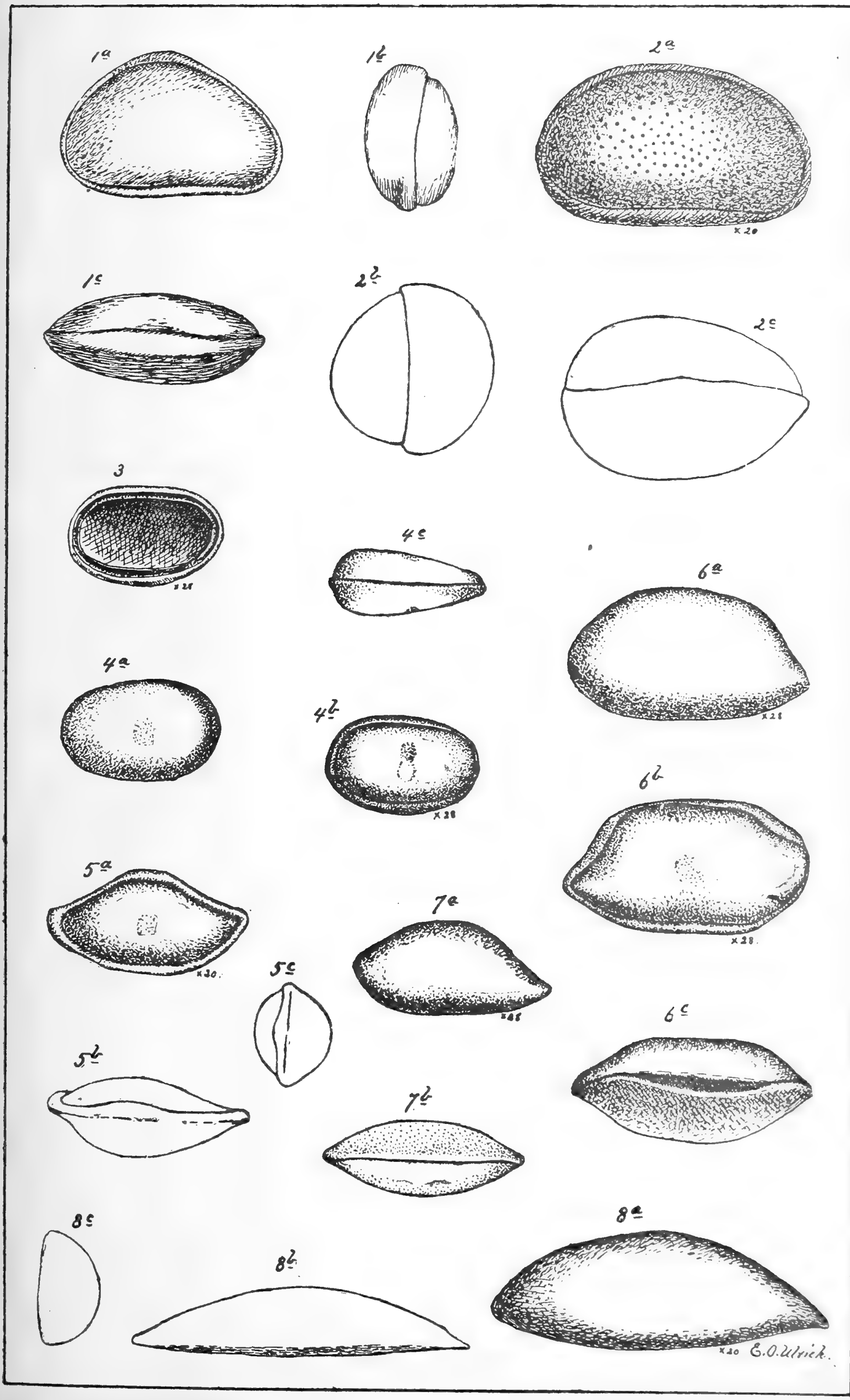
Figs. 6 and 7. Bairdia cestriensis, n. sp.................. 210

6*a*, 6*b* and 6*c*, left side, right side, and dorsal views, x 28, of an old example

7*a* and 7*b*, left side and ventral views of a small specimen, x 28. Both from Caldwell Co., Ky.

Fig. 8. Pontocypris (?) acuminata, n. sp.................. 210

8*a*, 8*b* and 8*c*, side, ventral, and posterior views of a left valve, x 20.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5a
x 30.
7a
5c
6c
5b
7b
8c
8b
8a
x 20 E.O. Ulrich.

Plate XVIII.

Page.

Fig. 1. Leperditia nicklesi, n. sp....................... 200

1*a*, 1*b* and 1*c*, side, anterior, and ventral views, x 28, of a left valve. Columbia, Ill.

1*d*, interior of another left valve; narrower in front; x 28.

1*e*, sectional view of ventral portion of carapace, showing method of overlap.

Fig. 2. Kirkbya (? Barychilina) costata (McCoy)......... 208

2*a* and 2*b*, side and edge views of a valve of this species, x 20. Columbia, Ill.

Fig. 3. Kirkbya venosa, n. sp........................ 208

3*a*, side and posterior views of a right valve, x 28; from Chester group, near Grayson Springs, Ky.

Figs. 4 and 5. Kirkbya oblonga, Jones and Kirkby........ 206

4*a* and 4*b*, side and end views of a symmetrical valve of this species, x 28. Chester, Ill.

5*a* and 5*b*, side and end views of an unsymmetrical right valve, x 28. Near Grayson Springs, Ky.

Fig. 6. Kirkbya lindahli, n. sp........................ 207

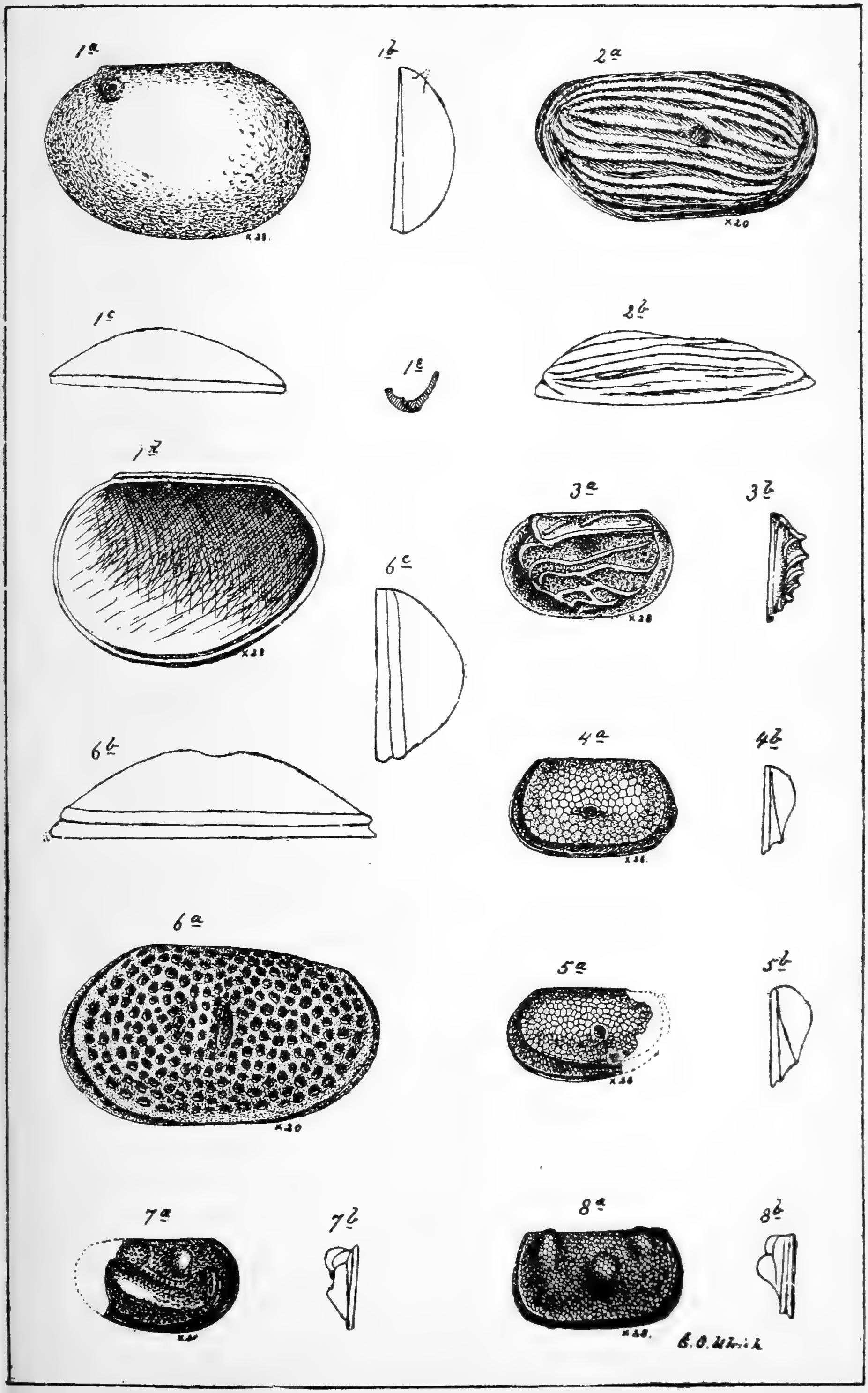
6*a*, 6*b* and 6*c*, side, ventral, and posterior views, x 20, of a medium sized right valve. Columbia, Ill.

Fig. 7. Beyrichia simulatrix, n. sp...................... 205

7*a* and 7*b*, side and posterior views of a left valve, x 28. Near Grayson Springs, Ky.

Fig. 8. Kirkbya tricollina, Jones and Kirkby.......... 207

8*a* and 8*b*, side and end views, x 28, of a (? right) valve of this species. Near Grayson Springs, Ky.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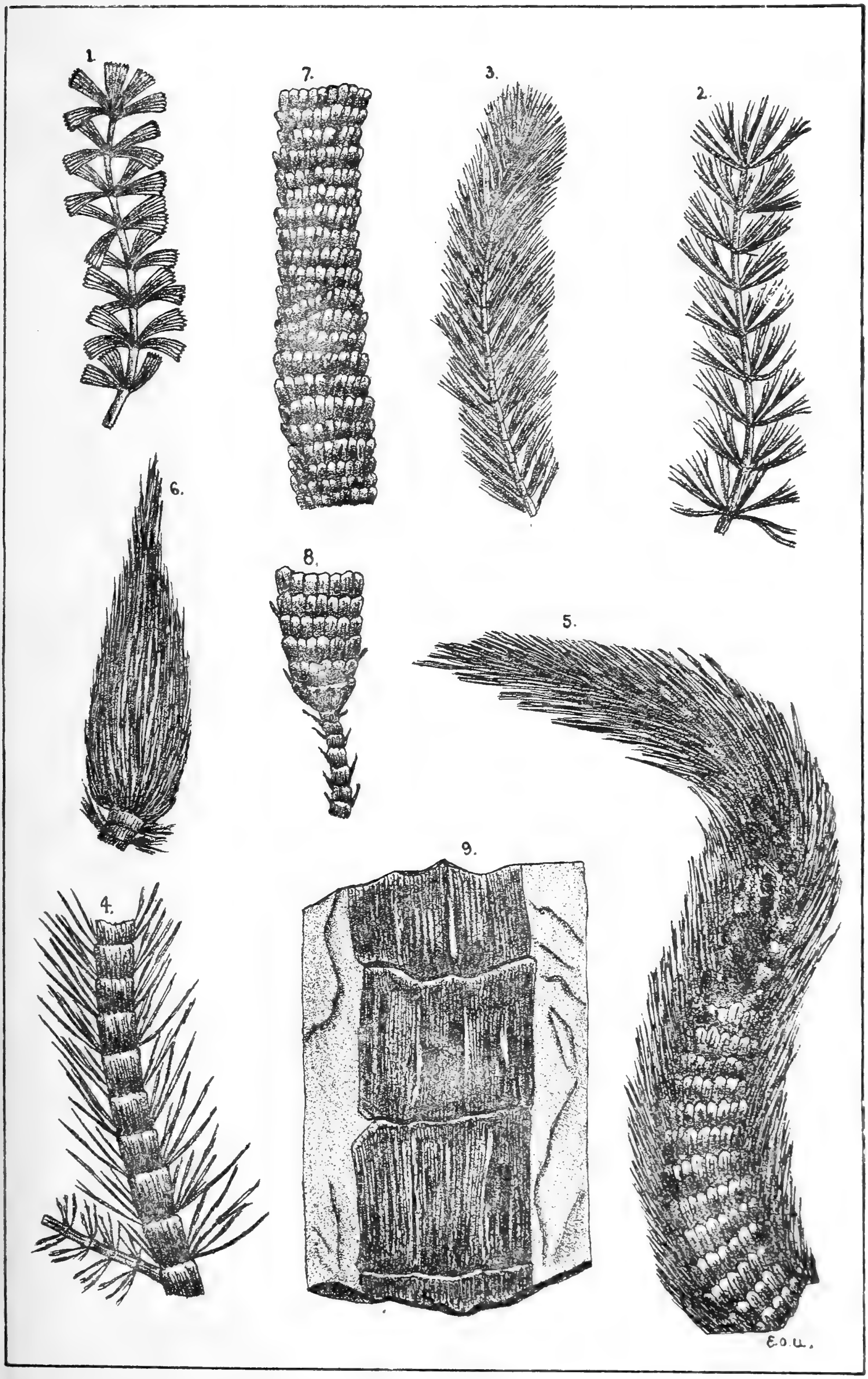
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